SESHADRI RAO
GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, GUDLAVALLERU-521 356, Krishna District, A.P., India
(Approved by AICTE, New Delhi and Permitted by A.P. State Government)
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1.2.2 List of courses offered to the students as an elective course. (Data for the latest completed academic year)

S.No	Programme name	Regulations	Type of Elective Course	List of Elective Courses
1	BTECH-CE BTECH-EEE BTECH-ME BTECH-ECE BTECH-CSE BTECH-IT BTECH-AIDS BTECH-IOT BTECH-CSE(AIML)	R20	Open Elective-1	Elements of Civil Engineering (Other than CE)
2				Environment Laws and Policies (other than CE)
3				Electrical Materials (other than EEE)
4				Control Systems Engineering (Other than EEE & ECE)
5				Automotive Engineering (Other than ME)
6				Elements of Mechanical Transmission (other than ME)
7				Introduction to Embedded systems (other than ECE/IoT)
8				Fundamentals of Communication Systems (other than ECE/IoT)
9				Information Retrieval Systems (Other than CSE & AI&DS)
10				Computer Graphics (Other than CSE, IT & AI&DS)
11				System Software (Other than IT)
12				Free & Open-Source Software Other than IT)
13				Fuzzy Mathematics
14	BTECH-CE	R17	Professional Elective-1	Advanced Strength of Materials
15				GIS and GPS
16				Green Buildings
17				Construction Management

18	BTECH-CE BTECH-EEE BTECH-ME BTECH-ECE BTECH-CSE BTECH-IT	R17	Open Elective-II	Geoinformatics (other than CE)
19				Environmental Sanitation
20				Modelling & Simulation of Engineering Systems
21				Power Systems Engineering Other than EEE)
22				Elements of Mechanical Transmission Other than ME)
23				Material Handling Equipment
24				Automotive Electronics
25				Introduction to MEMS other than ECE)
26				Data Science
27				Virtual and Augmented Reality (other than IT)
28				Open Source Software
29				Cyber Laws
30				Quality, Reliability and Operations Research
31	BTECH-CE	R17	Optional Elective - III	Infrastructure Development
32				Basics of Power Plant Engineering
33				Object Oriented Programming through JAVA
34	BTECH-CE	R17	Optional Elective - IV (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
35	BTECH-CE	R17	Professional Elective-II	Advanced Structural Analysis
36				Environmental Pollution and Its Control
37				Ground Water Development and Management
38				Ground Improvement Techniques
39	BTECH-CE BTECH-EEE BTECH-ME BTECH-ECE BTECH-CSE BTECH-IT	R17	Open Elective-III	Hydrology (Other than CE)
40				Planning for Sustainable Development
41				Electrical and Hybrid Vehicles
42				Power Plant Instrumentation
43				Material Science (Other than ME)
44				Renewable Energy Sources (Other than ME)
45				Assistive Technologies (Other than ECE)
46				Bio-Medical Engineering (Other than EEE & ECE)
47				Node and Angular JS
48				Cyber Security
49				Scripting Languages (Other than CSE)

50				Software Project Management (Other than CSE)
51				Elements of Stochastic Processes
52				Academic Communication
53	BTECH-CE	R17	Optional Elective - V	Smart Buildings and Automation
54				Building Information Modelling
55				Database Management Systems
56	BTECH-CE	R17	Optional Elective - VI (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
57	BTECH-CE	R17	Professional Elective-III	Pre-stressed Concrete
58				Advanced Foundation Engineering
59				Traffic Engineering
60				Industrial Wastewater Management
61	BTECH-CE	R17	Professional Elective-IV	Advanced Design of RC Structures
62				Hydraulic Structures
63				Geosynthetics
64				Disaster Preparedness and Planning
65	BTECH-CE BTECH-EEE BTECH-ME BTECH-ECE BTECH-CSE BTECH-IT	R17	Open Elective-IV	Disaster Management (Other than CE)
66				Repair and Retrofitting Techniques
67				Modern Optimization Techniques
68				Electrical Power Utilization (Other than EEE)
69				Green Engineering
70				Non-Destructive Evaluation (Other than ME)
71				Cyber Physical Systems
72				Signals and Systems (Other than EEE & ECE)
73				Digital Forensics
74				Business Intelligence and Decision Support Systems
75				Adhoc and Sensor Networks
76				Information Retrieval Systems (Other than CSE)
77				Fuzzy Logic (Other than EEE, ME & CSE)
78	BTECH-CE	R17	Optional Elective - VII	Project Scheduling and Contracts
79				Optimization Techniques
80				Entrepreneurship
81	BTECH-CE	R17	Optional Elective - VIII (MOOCs)	Students shall opt from the list of MOOCs given by the Department)

82	BTECH-CE	R17	Professional Elective-V	Earthquake Resistant Design of Structures
83				Logistics Infrastructure Engineering
84				Finite Element Methods
85				Design and Drawing of Irrigation Structures
86	BTECH-CE	R17	Professional Elective-VI	Pre-Engineered Buildings
87				Urban Transportation Planning
88				Soil Dynamics and Machine Foundations
89				Environmental Impact Assessment
90	BTECH-EEE	R17	Professional Elective-1	Switch Gear and Protection
91				Computer Networks
92				Pulse and Integrated Circuits
93				Data Structures
94	BTECH-EEE	R17	Optional Elective - III	Mechatronics
95				Object Oriented Programming Through Java
96				Control System Design
97	BTECH-EEE	R17	Optional Elective - IV (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
98	BTECH-EEE	R17	Professional Elective-II	Digital Signal Processing
99				Embedded System Design
100				Principles of VLSI Design
101				DSP Processors and Architecture
102	BTECH-EEE	R17	Optional Elective - V	Data Base Management Systems
103				Nano Electronics
104				Solar and Wind Energy Systems
105	BTECH-EEE	R17	Optional Elective - VI (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
106	BTECH-EEE	R17	Professional Elective-III	Big Data Analytics
107				CMOS Digital IC Design
108				Power Semiconductor Drives
109				Flexible AC Transmission Systems
110	BTECH-EEE	R17	Professional Elective-IV	Cyber Security
111				Digital Image Processing
112				Power System Operation & Control
113				High Voltage Engineering
114	BTECH-EEE	R17	Optional Elective - VII	Analog and DigitalCommunication
115				Introduction to Python Programming
116				Integration of Renewable Energy Sources

117	BTECH-EEE	R17	Optional Elective - VIII (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
118	BTECH-EEE	R17	Professional Elective-V	Electrical Distribution System
119				Artificial Intelligence Techniques
120				Advanced Control Systems
121				Energy Audit, Conservation and Management
122	BTECH-EEE	R17	Professional Elective-VI	Special Electrical Machines
123				Digital Control Systems
124				Utilization of Electrical Energy
125				HVDC Transmission Systems
126	BTECH-ME	R17	Professional Elective-1	Non Conventional Sources of Energy
127				Mechanical Vibrations
128				Mechanics of Composite Materials
129				Data Structures
130	BTECH-ME	R17	Optional Elective - III	Computer Graphics
131				Fuzzy Logic Systems
132				Micro Processors and Interfacing
133	BTECH-ME	R17	Optional Elective - IV (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
134	BTECH-ME	R17	Professional Elective-II	Principles of Finite Element Method
135				Robotics
136				Automobile Engineering
137				Database Management Systems
138	BTECH-ME	R17	Optional Elective - V	Object Oriented Programming through Java
139				ME2549 ii) Mechatronics
140				EC2512iii) Embedded System Design
141	BTECH-ME	R17	Optional Elective - VI (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
142	BTECH-ME	R17	Professional Elective-III	Optimization Techniques
143				Refrigeration and Air Conditioning
144				Unconventional Machining Process
145				Tribology
146	BTECH-ME	R17	Professional Elective-IV	Total Quality Management
147				Computational Fluid Dynamics
148				Condition Monitoring
149				Design of Transmission Elements

150	BTECH-ME	R17	Optional Elective - VII	Big Data Analytics
151				Computer Organization and Architecture
152				Cryogenics
153	BTECH-ME	R17	Optional Elective - VIII (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
154	BTECH-ME	R17	Professional Elective-V	Design for Manufacturing and Assembly
155				Production Planning and Control
156				Power Plant Engineering
157				Theory of Elasticity
158	BTECH-ME	R17	Professional Elective-VI	Rapid Prototyping
159				Gas Dynamics and Jet Propulsion
160				Automation in Manufacturing
161				Non Destructive Techniques
162	BTECH-ECE	R17	Professional Elective-1	CAD for VLSI
163				Computer Organization
164				Computer and Communication Networks
165				Biomedical Engineering
166	BTECH-ECE	R17	Optional Elective - III	Data Warehousing and Data Mining
167	BTECH-ECE			Mechatronics
168	BTECH-ECE			Introduction to MEMS
169	BTECH-ECE	R17	Optional Elective - IV (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
170	BTECH-ECE	R17	Professional Elective-II	Analog IC Design
171				Nano Electronics
172				Smart Antennas
173				Coding Theory
174	BTECH-ECE	R17	Optional Elective - V	Big Data Analytics
175				Cognitive Radio Networks
176				Cryptography and Network Security
177	BTECH-ECE	R17	Optional Elective - VI (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
178	BTECH-ECE	R17	Professional Elective-III	Mixed Signal IC Design
179				Cellular and Mobile Communications
180				Digital TV Engineering
181				DSP Processors and Architectures
182	BTECH-ECE	R17	Professional Elective-IV	System on Chip Design
183				Wireless Sensor Networks
184				Satellite Communication
185				Digital Image Processing

186	BTECH-ECE	R17	Optional Elective - VII	Digital Control Systems
187				Artificial Intelligence
188				Transform Techniques
189	BTECH-ECE	R17	Optional Elective - VIII (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
190	BTECH-ECE	R17	Professional Elective-V	Low Power VLSI Circuits
191				Real Time Operating Systems
192				Speech Processing
193				Adaptive Signal Processing
194	BTECH-ECE	R17	Professional Elective-VI	ASIC Design
195				Embedded C
196				RADAR Engineering
197				Multi Rate Signal Processing
198	BTECH-CSE	R17	Professional Elective-1	C#.NET
199				Advanced Data Structures
200				Software Testing Methodologies
201				Principles of Programming Languages
202	BTECH-CSE	R17	Optional Elective - III	Human Computer Interaction
203				Digital Signal Processing
204				Control Systems
205	BTECH-CSE	R17	Optional Elective - IV (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
206	BTECH-CSE	R17	Professional Elective-II	Artificial Intelligence
207				Scripting Languages
208				Microprocessors and Interfacing
209				Software Project Management
210	BTECH-CSE	R17	Optional Elective - V	Graph Theory
211				Embedded System Design
212				Digital Control Systems
213	BTECH-CSE	R17	Optional Elective - VI (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
214	BTECH-CSE	R17	Professional Elective-III	Machine Learning
215				Internet of Things
216				NoSQL Databases
217				Software Requirements Engineering and Estimation
218	BTECH-CSE	R17	Professional Elective-IV	Mobile Computing
219				Image Processing
220				Information Retrieval Systems
221				Optimization Techniques
222	BTECH-CSE	R17	Optional Elective - VII	Network Programming
223	BTECH-CSE	R17	Optional Elective - VII	Systems Software

224	BTECH-CSE	R17	Optional Elective - VII	Robotics
225	BTECH-CSE	R17	Optional Elective - VIII (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
226	BTECH-CSE	R17	Professional Elective-V	Web Mining
227				Cloud Computing
228				Agile Software Development Process
229				Blockchain Technologies
230	BTECH-CSE	R17	Professional Elective-VI	Distributed Systems
231				Social Networks
232				Web Services
233				Deep Learning
234	BTECH-IT	R17	Professional Elective-1	Artificial Intelligence
235				Embedded System Design
236				Computer Graphics
237				Advanced Data Structures
238	BTECH-IT	R17	Optional Elective - III	Object Oriented Programming through C++
239				Data Communication
240				Building Information Modelling
241	BTECH-IT	R17	Optional Elective - IV (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
242	BTECH-IT	R17	Professional Elective-II	Soft Computing Techniques
243				Real Time Systems
244				Image Processing
245				Agile Software Development Process
246	BTECH-IT	R17	Optional Elective - V	Secure Web Technologies
247				Management Information Systems
248				Robotics
249	BTECH-IT	R17	Optional Elective - VI (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
250	BTECH-IT	R17	Professional Elective-III	Machine Learning and Pattern Recognition
251				Distributed Operating Systems
252				Human Computer Interaction
253				Software Testing Methodologies
254	BTECH-IT	R17	Professional Elective-IV	Business Intelligence
255				Mobile Computing
256				Multimedia Tools
257				Cryptography and Network Security

258	BTECH-IT	R17	Optional Elective - VII	Social Networks
259				Assistive Technologies
260				Renewable Energy Sources
261	BTECH-IT	R17	Optional Elective - VIII (MOOCs)	Students shall opt from the list of MOOCs given by the Department)
262	BTECH-IT	R17	Professional Elective-V	Steganography and Biometrics
263				Parallel Computing
264				Virtual and Augmented Reality
265				E-Commerce
266	BTECH-IT	R17	Professional Elective-VI	Internet of Things
267				Cloud Computing
268				Block chain Technologies
269				Design Patterns
270	M. Tech-SE	R20	Professional Elective-I	Computational Methods in Structural Engineering
271				Advanced R.C. Design
272				Experimental Stress Analysis
273	M. Tech-SE	R20	Professional Elective-II	Theory of Plates and Shells
274				Advancements in Concrete Technology
275				Design of Pre-stressed Concrete Structures
276	M. Tech-SE	R20	Professional Elective-III	Advanced Design of Steel Structures
277				Stability of Structures
278				Design of High-rise Structures
279	M. Tech-SE	R20	Professional Elective-IV	Design of Bridge Structures
280				Repairs and Retrofitting of Structures
281				Ground Improvement Methods
282	M. Tech-SE	R20	Professional Elective-V	Earthquake Resistant Design of Structures
283				Design of Sub-structures
284				MOOCs
285	M. Tech-SE M. Tech-PEED M. Tech-MD M. Tech-VLSI&ED	R20	Open Elective	Sustainable Development
286				Energy Audit, Conservation & Management
287				Rapid Prototyping
288				Automotive Electronics
289				Soft Computing Techniques
290	M. Tech-PEED	R20	Professional Elective-I	Modern Control Theory
291				Power Quality and Custom Power Devices
292				Programmable Logic Controllers and Applications
293	M. Tech-PEED	R20	Professional Elective-II	Artificial Intelligence Techniques
294				Renewable Energy Technologies

295				Flexible AC Transmission Systems
296	M. Tech-PEED	R20	Professional Elective-III	Control and Integration of Renewable Energy Systems
297				Hybrid Electric Vehicles
298				Advanced Digital Control Systems
299	M. Tech-PEED	R20	Professional Elective-IV	Advanced Digital Signal Processing
300				Applications of Power Converters
301				Microcontrollers
302	M. Tech-PEED	R20	Professional Elective-V	Digital Signal Processing Controlled Drives
303				Smart Grid Technologies
304				MOOCs
305	M. Tech-MD	R20	Professional Elective-I	Analysis and Synthesis of Mechanisms
306				Advanced Materials
307				Industrial Robotics
308	M. Tech-MD	R20	Professional Elective-II	Gear Engineering
309				Advanced Optimization Techniques
310				Rotor Dynamics
311	M. Tech-MD	R20	Professional Elective-III	Design for Manufacturing and Assembly
312				Mechatronics
313				Vehicle Dynamics
314	M. Tech-MD	R20	Professional Elective-IV	Signal Analysis and Condition Monitoring
315				Fracture Mechanics
316				Experimental Stress Analysis
317	M. Tech-MD	R20	Professional Elective-V	Tribology
318				Composite Materials
319				MOOCs
320	M. Tech-VLSI&ED	R20	Professional Elective-I	Testing and Testability of VLSI Circuits
321				Advanced Digital Design
322				Digital Signal and Image Processing
323	M. Tech-VLSI&ED	R20	Professional Elective-II	VLSI Signal Processing
324				System Design with Embedded Linux
325				Parallel Processing
326	M. Tech-VLSI&ED	R20	Professional Elective-III	Advances in VLSI Design
327				Embedded Computer Architecture
328				System on Chip Design
329	M. Tech-VLSI&ED	R20	Professional Elective-IV	VLSI Interconnects
330				Communication Buses and Interfaces
331				Advanced Digital Signal Processing

332	M. Tech-VLSI&ED	R20	Professional Elective-V	Lower Power VLSI Design
333				Network Security and Cryptography
334				MOOCs
335	M. Tech-AI&ML	R20	Professional Elective-I	Digital Image Processing
336				Ad hoc and Sensor Networks
337				Intelligent Systems
338	M. Tech-AI&ML	R20	Professional Elective-II	Internet of Things
339				Principles of Computer Security
340				Distributed Systems
341	M. Tech-AI&ML	R20	Professional Elective-III	Internet of Things
342				Principles of Computer Security
343				Distributed Systems
344	M. Tech-AI&ML	R20	Professional Elective-IV	Cloud Computing
345				Quantum Computing
346				Digital Forensics
347	M. Tech-AI&ML	R20	Professional Elective-V	Deep Learning
348				Recommender Systems
349				MOOCs-1 (NPTEL/SWAYAM)
350	M. Tech-AI&ML	R20	Open Elective	Soft Computing Techniques
351	M. Tech-AI&ML	R20	Open Elective	MOOCs-2 (NPTEL/SWAYAM)-
352	MBA	R20	Elective	Advertising & Brand Management
353	MBA			Consumer Behavior
354	MBA			Security Analysis & Portfolio Management
355	MBA			International Financial Management
356				Human Resource Analytics
357	MBA			Industrial Relations and Labor Laws
358	MBA			Marketing of Services
359	MBA			Sales & Distribution Management
360	MBA			Financial Derivatives
361	MBA			Financial Institutions and Services
362	MBA			Compensation Management
363	MBA			Management of Change and Development

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PRINCIPAL

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Seshadri Rao
Gudlavalleru Engineering College
Seshadri Rao Knowledge Village
Gudlavalleru - 521 356, Krishna District. A.P.

Open Elective - I

ELEMENTS OF CIVIL ENGINEERING

II Year – II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To introduce basics of Civil Engineering concepts in the fields of surveying, building materials, water resources, Water Supply, Sanitary, Electrical Works in Building and Highway Engineering.

Course Outcomes

Upon successful completion of the course, the students will be able to

- familiarize with basics of civil engineering.
- carryout various civil engineering survey works.
- identify the various properties of building materials and various types of buildings.
- get acquainted with fundamentals of Water Resources, Water Supply, Sanitary and Electrical Works in Building.
- enumerate the fundamental concepts highway engineering.

Course Content

UNIT - I: Introduction

Introduction of Civil Engineering, Scope of Civil Engineering, Role of Civil Engineer in Society. Impact of infrastructural development on economy of country.

UNIT - II: Surveying and Leveling

Introduction: Definition of Surveying, Fundamental principles of surveying, Classification of surveying.

Linear Measurement: Methods, Instruments used in chain surveying, Selection of stations, Chaining and Ranging

Angular Measurement: Instruments used, Types of compass, Types of meridians and bearings, Measurement of bearings, computation of angles. Compass traversing local attraction.

Leveling: Objectives and applications-terminology-Instruments,component parts of dumpy level, Types of leveling, levelling staff.

UNIT - III: Building Materials and Construction

Materials: Introduction to construction materials - Stones, Bricks, Lime, Cement, Timber, Sand, Aggregates, Mortar, Concrete and bitumen.

Construction: Classification of buildings, Building components and their functions.

UNIT - IV: Water Resources, Water Supply, Sanitary and Electrical Works in Building

Hydrologic cycle, water use and its conservation, Introduction to dams, barrages and check dams.

Introduction, water supply system, water supply layout of a building, housedrainage, traps, electrical works in building.

UNIT - V: Transportation Engineering

classification of roads, Introduction of flexible and rigid pavements, Introduction to road traffic and traffic control mechanism.

Text Books

1. Elements of Civil Engineering, Mimi Das Saikia, Bhargab Mohan Dasand Madan Mohan Das Publisher: PHI Learning Private Limited New Delhi.
2. Basic Civil Engineering, Dr. B.C Punmia,Ashok.K. Jain and Arun K. Jain: Laxmi Publications,Delhi.
3. Surveying Vol. I, Dr. B. C. Punmia, Ashokkumar Jain, ArunkumarJain, 17th Edition Publisher: Laxmi Publications ,Delhi.

Reference Books

1. Surveying and Leveling, R. Subramanian, Publisher: Oxford University.
2. Building drawing, M.G.Shah, C.M.Kale and S.Y.Patki Publisher: TataMcGraw Hill.

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Open Elective - I

ENVIRONMENTAL LAWS AND POLICIES

II Year – II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To equip the students to have a basic awareness on environmental and socioeconomic Factors.
- To impart the knowledge of environmental pollution problem.
- To elucidate the rules and regulations of patents and trade laws.

Course Outcomes

Upon successful completion of the course, the students will be able to

- comprehend different moral perspectives and one's own Ethical standards.
- understand the concept of safety and risk.
- explain different initiatives to protect nature.
- identify the role of Environmental Engineering.
- understand different types of infringement of Intellectual Property Rights.

Course Content

UNIT - I: Introduction

Introduction to trade and environment - International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment, Environment and conflicts management, Famous international protocols like Kyoto.

UNIT - II: Environmental Laws

Overview of environment, Nature and eco system, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, Sustainable development and environment, Understanding climate change, Carbon crediting, Carbon foot print etc.

UNIT - III: Air and Noise Pollution Control Laws

Air pollutants, Sources, classification, Combustion, Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, Smog and ozone layer disturbance, Greenhouse effect. Air sampling and pollution measurement methods, Principles and instruments, Overview of air pollution control laws and their mitigation measures. Sound power, Sound intensity and sound pressure levels; Plane, Point and line sources, Multiple sources; Outdoor and indoor noise propagation;

Psychoacoustics and noise criteria, Effects of noise on health; Special noise environments: Infrasound, Ultrasound, Impulsive sound and sonic boom; Noise standards and limit values; Noise instrumentation and monitoring procedure, Noise control methods.

UNIT - IV: Water Quality Laws

Introduction to water quality laws development, calibration and verification cost: benefit analysis using models, Laws for estuary and lakes, Waste water treatment legislation; Introduction to water quality management systems and procedures, Consequence Analysis; Socioeconomic aspects, Measures of effectiveness of pollution control activities.

UNIT - V: Environmental Impact Assessment and Life Cycle Analyses

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and comprehensive EIA; General framework for environmental impact assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of risk, Matrix method - Checklist method, Fault tree analysis, Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource balance, Energy balance & management review; Operational control; Case studies on EIA.

Text Books

1. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.
2. A Textbook of Environmental Chemistry, by O. D. Tyagi and M. Mehra
3. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, economical and Working Environment, 120th ASEE Annual Conference and Exposition.

Reference Books

1. Larry W. Canter, "Environmental Impact Assessment", 1st edition, McGraw-Hill (international edition).
2. David P. Lawrence, "Environmental Impact Assessment - Practical Solutions to Recurrent Problems", 1st Edition, Wiley-Interscience.
3. Advanced Air and Noise Pollution Control, Lawrence K. Wang, Norman C. Pereira, Yung-Tss Hung, 2005 Edition, Humana Press.
4. Municipal Solid Waste Management, P. Jayarami Reddy, 1st Edition, B.S. Publications.

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Open Elective - I

ELECTRICAL MATERIALS

II Year – II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To introduce the concepts of dielectric and ferro-magnetic materials.
- To impart knowledge on semiconductor materials, materials used in batteries and solar cells.
- To familiarize the materials required for specific electrical applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe the properties of liquid, gaseous and solid dielectric materials used in electrical applications.
- analyze the properties of Ferro electric, Peizo electric and Pyro electric materials.
- classify different magnetic materials and examine the effects of aging and impurities on magnets.
- elucidate various semiconductor materials and their applications in integrated circuit.
- choose appropriate material for a given electical and special purpose application.

Course Content

UNIT - I: Dielectic Materials

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics.

UNIT - II: Ferromagnetic Materials

Properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials, applications of Ferro-electric materials.

UNIT - III: Magnetic Materials

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, Magnetostriction, magnetically soft and hard materials, ageing of magnets, Superconductivity and its origin, Zero resistance and Meissner Effect.

UNIT - IV: Semiconductor Materials

Properties of semiconductors, Classification of Semiconductors, Silicon wafers - Wafer manufacturing process, Resistor, Fabrication processes of MOSFET on IC.

UNIT - V: Materials for Electrical Applications

Materials used for Resistors, rheostats, heaters, stranded conductors, fuses, electric contact materials, Solid Liquid and Gaseous insulating materials. Effect of moisture on insulation, Testing of Transformer oil as per ISI standards - Galvanization methods, Materials for battery and solar cells.

Text Books

1. R K Rajput: A course in Electrical Engineering Materials, Laxmi Publications. 2009.
2. David Linden, Thomas B. Reddy "The Handbook of Batteries" McGraw-Hill Hand Books 2010.
3. T K BasaK: A course in Electrical Engineering Materials:, New Age Science Publications 2009.

Reference Books

1. TTTI Madras: Electrical Engineering Materials
2. Adrianus J.Dekker: Electrical Engineering Materials , THM Publication

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Open Elective - I

CONTROL SYSTEMS ENGINEERING

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To equip the students with the basic concepts of control systems by developing mathematical models for physical systems.
- To familiarize with the time domain behavior of linear control systems.
- To impart knowledge on analytical methods to quantify stability of linear control systems.
- To introduce the state space analysis to continues time systems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the basic concepts and properties of feedback control systems for mathematical modeling of physical systems.
- explore the transfer function analysis using singal flow graph representation of control systems.
- employ the time domain analysis to quantify the performance of linear control systems and specify suitable controllers.
- perform frequency domain analysis of control systems required for stability analysis.
- use the concept of state variable theory to determine the dynamic behavior of linear control systems.

Course Content

UNIT - I: Introduction

Concepts of Control Systems- Open loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer function for physical systems.

UNIT - II: Control Systems Components

Transfer Function of DC Servo motor - AC Servo motor -, Block diagram representation of systems considering -Block diagram algebra – Representation by signal flow graphs - Reduction is using Mason's gain formula.

UNIT - III: Time Response Analysis

Standard test signals - Time response of first order systems – Characteristic equation of feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants.

UNIT - IV: Stability Analysis in S-Domain

The Concept of Stability – Routh's Stability Criterion – Qualitative Stability and Conditional Stability –Limitations of Routh's Stability.

Root Locus Technique: The root locus concept - construction of root loci – simple problems.

UNIT - V: State Space Analysis of Continuous Systems

Concept of state, state variables and state model, derivation of state models from physical systems, solving the Time invariant state equations- State Transition Matrix and its Properties, concept of controllability and observability.

Text Books

1. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International Limited Publishers, 6^{th} edition, 2017.
2. Automatic control system – B.C.Kuo , john wiley and son's 8th edition, 2003.

Reference Books

1. Modern control engineering – K.Ogata , prentice Hall of India Pvt. Ltd., 5^{th} Edition, 2015.
2. Control system – N.K.Sinha, New Age International (p) Limited Publishers, 3rd Edition, 1998.
3. Control system engineering – Norman S-Nice, Willey Studio Edition, 4th Edition. Feed back and control system – Joseph J Distefa.
4. Modern control systems - Richard C. Dorf and Robert H. Bishop, Pearson Prentice Hall Publications, 12^{th} Edition, 2010.

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Open Elective - I

AUTOMOTIVE ENGINEERING

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To introduce various components and sub systems of an automobile.
- To impart knowledge on various safety systems of an automobile and emission norms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- outline the various components and sub systems of an automobile.
- specify different safety norms for the operation of an automobile.

Course Content

UNIT - I:

Introduction: classification of automobiles, components of four wheeler automobile-chassis, body, power unit, power transmission- front wheel drive, rear wheel drive, four-wheel drive.

Fuel supply systems: Simple fuel supply system in petrol and diesel engines. working of simple carburettor, direct fuel injection system in diesel engine.

UNIT - II:

Lubricating System: Functions & properties of lubricants, methods of lubrication splash, pressure, dry sump and wet sump lubrication.

Cooling System: Necessity, methods of cooling - air cooling & water cooling, components of water cooling, radiator, thermostat.

UNIT - III:

Ignition System: Functions, requirements, types of an ignition system, battery ignition system - components, Magneto ignition system, electronic ignition system.

Transmission system: Types and functions of the clutches- single plate clutch, multi plate clutch, centrifugal and semi centrifugal clutch, types of gear boxes-Sliding mesh, Constant mesh, Synchromesh, propeller shaft, universal joint and differential.

UNIT - IV:

Suspension System: Objectives of suspension system, front suspension systemrigid axle suspension system, independent suspension system, rear axle suspension, torsion bar, shock absorber.

Braking System: Mechanical brakes, hydraulic brakes-master cylinder, wheel cylinder, tandem master cylinder, brake fluid, air brakes and vacuum brakes.

UNIT - V:

Emissions from Automobile: Emission norms - Bharat stage and Euro norms. engine emissions - exhaust and non-exhaust.

Safety Systems: seat belt, air bags, bumper, antilock brake system (ABS), wind shield, suspension sensor, traction control, central locking, electric windows, speed control.

Text Books

1. Kirpal Singh, "Automobile Engineering Vol-1 & vol-2", Standard Publishers Distributors, 14 th edition, 2017 .
2. William H Crouse & Donald LAnglin, Automotive Mechanics, Tata Mc Graw Hill Publications, 10th edition, 2017.

Reference Books

1. R.B Gupta , Automobile Engineering, Satya Prakashan Publications, 6th edition,2016.
2. Newton steeds & Garrett, "The Motor vehicle", Society of Automotive Engineers, 13th edition,2001.
3. G.B.S. Narang, "Automobile Engineering", Khanna Publishers, 5th edition, 1995.

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Open Elective - I

ELEMENTS OF MECHANICAL TRANSMISSION

II Year – II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the principles of mechanical power transmission elements.

Course Outcomes

Upon successful completion of the course, the students will be able to

- choose suitable shaft couplings for a given application.
- propose suitable transmission element for a given application.
- identify suitable power screw for motion transmission.

Course Content

UNIT - I: Shaft Couplings

Shaft couplings: Rigid couplings – muff, split muff and flange couplings, flexible coupling-modified flange coupling.

UNIT - II: Belt Drives

Flat Belts: Introduction, selection of a belt drive, types of belt drives, length of belts, materials, belt joints, types of flat belt drives, power transmitted.

UNIT - III: V-Belt, Rope Drives & Chain Drives

V-belts: Introduction, Types of V-belts, ratio of driving tensions for V-belt, power transmitted.

Rope Drives: Introduction, classification of rope drives, power transmitted.

Chain drives: Introduction, chain drives, polygonal effect, selection of roller chains, length of chain.

UNIT - IV: Power Screws

Forms of threads, multi-start threads, right hand and left hand threads, nut, compound screw, differential screw.

UNIT - V: Gears and Gear Trains

Types, terminology, materials, law of gearing, velocity of sliding, forms of teeth, path of contact, arc of contact, interference, gear Trains - types, differential of an automobile.

Text Books

1. Bhandari, "Design of Machine Elements", Tata McGraw Hill book Co.,5th Edition, 2020.
2. P.C. Sharma & D.K. Agarwal, "Machine Design", S.K.Kataria & Sons ,13th Edition, 2018.

Reference Books

1. Sharma & Purohit, "Design of Machine Elements", PHI, 10th Edition,2011.
2. Kannaiah, "Design of Machine Elements", Scitech Publications, 2nd Edition, 2015.

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Open Elective - I

INTRODUCTION TO EMBEDDED SYSTEMS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To introduce the classification, characteristics, applications of embedded systems.
- To provide clear understanding about the role of firmware in correlation with hardware systems.
- To familiarize with the architecture of 8051 microcontroller.

Course Outcomes

Upon successful completion of the course, the students will be able to

- compare embedded and general computing systems.
- select the processors for an embedded system application.
- understand the architecture and instruction set of 8051 microcontroller.
- program the timers/counters and serial communication components of 8051 microcontroller.

Course Content

UNIT - I: Introduction to Embedded Systems

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT - II: Typical Embedded System: Core of the Embedded System

Elements of Embedded Systems, General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT - III: Embedded Firmware

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT - IV: Introduction to 8051 Microcontroller

Overview of 8051 microcontroller, Architecture, I/O Ports, Memory organization, Addressing modes and Instruction set of 8051, Simple programs.

UNIT - V: 8051 Real Time control

Interrupts- 8051 Interrupts, Interrupt Vector table of 8051, IE Register, IP register;Timers and Counters-Timer 0, Timer 1, TMOD Registers, TCON Register,Mode1 Programming; Serial Port- SBUF, SCON Registers, Doubling baud rate using PCON register, program for serial data transmission.

Text Books

1. K.V Shibu, "Introduction to Embedded System", TMH Education private limited, 2009.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontrollers and Embedded Systems", 2nd Edition, Pearson Education.

Reference Books

1. Kenneth. J. Ayala, Dhananjay V. Gadre, "The 8051 Microcontroller & Embedded Systems Using Assembly and C", 1st edition, Cengage learning, 2010.
2. Rajkamal," Embedded Systems" 2nd Edition, TMH, 2008.
3. Frank Vahid, Tony Givargis, "Embedded System Design", 2nd Edition, John Wiley Publishers.

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Open Elective - I

FUNDAMENTALS OF COMMUNICATION SYSTEMS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To introduce various analog and digital modulation and demodulation techniques
- To familiarize with various multiplexing schemes and cellular telephone systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the concepts of basic communication system
- compare different multiplexing techniques.
- differentiate DSB-SC, SSB and frequency modulation schemes.
- distinguish ASK, PSK and FSK modulations.
- know the concepts of the cellular telephone systems

Course Content

UNIT - I: Introduction to Communication Systems

Introduction, Communication Process: Elements of communication system, Concept of Bandwidth and frequency spectrum, Sources of information: Classification of signals, Baseband and Band pass signals, Communication channels, Classification of communication systems.

UNIT - II: Basic Models of Communication

Need of modulation, Different types of modulation systems, Multiplexing, Basic Models of Communication. Primary Communication Resources, Survey of communication applications, Analog and digital signals, Conversion of analog signals to digital signals, electromagnetic spectrum (EM) Spectrum.

UNIT - III: Linear Modulation

Basics of Amplitude Modulation: Definition and Physical Appearance, Single tone an AM wave, Frequency Spectrum and Bandwidth of an AM wave, Modulation Index, Power distribution in an AM wave; Forms of an AM signal (theoretical concepts): Double Side Band-suppressed Carrier (DSB-SC), Single Side Band (SSB).

UNIT - IV: Angle Modulation

Basics of Frequency Modulation: Definition and Physical Appearance, Frequency Deviation Curve, Equation of FM wave, Frequency Deviation, Modulation Index, Deviation Ratio; Comparison of FM and AM Signals.

Phase Modulation: Definition and Physical Appearance, Equation of PM wave.

UNIT - V: Digital Transmission

Digital communication system model, advantages and disadvantages of digital communication, pulse code modulation (PCM), ASK, FSK, PSK, Basics of cellular telephone systems.

Text Books

1. Wayne Tomasi, "Electronics Communication systems", Pearson Education, 5th edition, 2004.
2. Dr. Sanjay Sharma, "Communication Systems: Analog and Digital", Katson Books, 7th Reprint Edition, 2018.

Reference Books

1. Simon Haykin, John Wiley, "Principles of Communication Systems", 2nd Edition, John Wiley & Sons.
2. V. Chandra Sekar, "Analog Communication", Oxford University Press, 2010.
3. Dr. Sanjay Sharma, "Digital Communications", Katson Books.
4. B.P.Lathi, "Modern Analog and Digital Communication", 3rd Edition, Oxford reprint, 2004.

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Open Elective - I

INFORMATION RETRIEVAL SYSTEMS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To introduce basic concepts in information retrieval.
- To familiarize with applications of information retrieval techniques in the Internet or Web environment.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the basic theories in information retrieval systems.
- use inverted file as an index data structure to retrieve the documents from the database.
- create signature files for fast retrieval of text data.
- build PAT treesand PAT arrays for the given text document.
- use stemming algorithms to improve the performance of IR systems.

Course Content

UNIT - I: Introduction to Information Storage and Retrieval System

Introduction, Domain Analysis of IR systems and other types of Information Systems, IR System Evaluation. Introduction to Data Structures and Algorithms related to Information Retrieval: Basic Concepts, Data structures, Algorithms.

UNIT - II: Inverted files

Introduction, Structures used in Inverted Files, Building Inverted file using a sorted array, Modifications to Basic Techniques.

UNIT - III: Signature Files

Introduction, Concepts of Signature Files, Compression, Vertical Partitioning, Horizontal Partitioning.

UNIT - IV: New Indices for Text

PAT Trees and PAT Arrays: Introduction, PAT Tree structure, algorithms on the PAT Trees, Building PAT trees as PATRICA Trees, PAT representation as arrays.

UNIT - V: Stemming Algorithms

Introduction, Types of Stemming Algorithms, Experimental Evaluations of Stemming to Compress Inverted Files.

Text Books

1. Frakes W.B., Ricardo Baeza-Yates, "Information Retrieval Data Structures and Algorithms", Prentice Hall, 1992.
2. Ricardo Baeza-Yates, Bertheir Ribeiro-Neto, "Modern Information Retrieval", Pearson Education.
3. Robert Korfhage, "Information Storage & Retrieval", John Wiley & Sons.

Reference Books

1. Kowalski, Gerald, Mark T Maybury, "Information Retrieval Systems-Theory and Implementation", Kluwer Academic Press, 1997.
2. Information retrieval Algorithms and Heuristics, 2ndedition, Springer.

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Open Elective - I

COMPUTER GRAPHICS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To emphasize on functionalities of various graphic systems and geometric transformations
- To familiarize on visible surface detection methods and computer animations.

Course Outcomes

Upon successful completion of the course, the students will be able to

- outline different graphical display devices and drawing algorithms.
- illustrate different 2-D geometrical transformations on graphical objects
- interpret different line and polygon clipping algorithms
- infer different 3- D transformations and viewing functions on objects.
- summarize different surface detection methods and computer animations

Course Content

UNIT - I: Introduction

Introduction: Application of computer graphics, raster scan and random scanDisplays.

Filled Area Primitives: Points and lines, inside and outside tests, line drawing algorithms, Scan line polygon fill algorithm.

UNIT - II: 2-D Geometrical Transforms

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transformations.

UNIT - III: 2D Viewing

The viewing pipeline, window to view-port coordinate transformation, Cohen-Sutherland line clipping algorithm, Sutherland – Hodgeman polygon clipping algorithm.

UNIT - IV: 3D Geometric Transformations

Translation, rotation, scaling, reflection and shear transformations, composite transformations, types of projections.

UNIT - V: Visible Surface Detection Methods and Animation

Classification – types, back-face detection, depth-buffer, BSP tree, area sub-division method.

Animations: General computer animation, raster animation, key frame systems, Graphics programming using Open GL .

Text Books

1. Donald Hearn, M. Pauline Baker, "Computer Graphics *C* version", 2nd e edition, Pearson Education.
2. Francis S.Hill, Stephen M. Kelley, "Computer Graphics using Open GL", 3rd edition, Pearson Education.

Reference Books

1. Foley, VanDam, Feiner, Hughes, "Computer Graphics Principles and Practice", 2nd edition, Pearson Education.
2. Rajesh K Maurya, "Computer Graphics with Virtual Reality Systems", Wiley.

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Open Elective - I

SYSTEM SOFTWARE

II Year – II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the implementation details of assemblers, loaders, linkers, and macro processors.

Course Outcomes

Upon successful completion of the course, the students will be able to

- outline the relationship between system software and machine architecture.
- analyze working of assembler for a simplified Instructional computer.
- describe the important features of linkage Editors and Dynamic Linking .
- identify the mostly used macro processors algorithms and data structures.
- compare the functions of Absolute Loader , Bootstrap Loaders.

Course Content

UNIT - I: Introduction

System software and machine architecture, The Simplified Instructional Computer (SIC), Machine architecture, Data and instruction formats, addressing modes, instruction sets, I/O and programming System.

UNIT - II: Assemblers

Basic assembler functions, SIC assembler, assembler algorithm and data structures, machine dependent assembler features.

UNIT - III: Implementation of Assemblers

Instruction formats and addressing modes, program relocation, machine independent assembler features, literals, symbol, defining statements, expressions, one pass assemblers, multi pass assemblers, implementation example, MASM assemble.

UNIT - IV: Loaders & Linkers

Basic loader functions, design of an absolute loader, simple bootstrap loader, machine dependent loader features, relocation, loader options, program linking, algorithm and data structures for linking loader, linkage editors, dynamic linking, implementation example.

UNIT - V: Macro Processors

Basic macro processor functions, macro definition and expansion, macro processor algorithm and data structures, machine independent macro processor features, concatenation of macro parameters, generation of unique labels, conditional macro expansion.

Text Books

1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd edition, Pearson Education Asia, 2000.

Reference Books

1 D. M. Dhamdhere, "Systems Programming and Operating Systems", 2nd Revised edition, Tata McGraw-Hill, 1999.

2. John J. Donovan "Systems Programming", Tata McGraw-Hill Edition, 1972.

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Open Elective - I

FREE & OPEN SOURCE SOFTWARE

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To impart the opportunities for open source software in the global market.
- To familiarize with different steps in implementing the open source.

Course Outcomes

Upon successful completion of the course, the students will be able to

- state the need and applications of open source software.
- compare and Contrast between Open source and commercial software
- demonstrate LINUX operating systems concepts.
- create database in MYSQL and perform operations on it.
- design and develop a web application using PHP.

Course Content

UNIT - I: Introduction

Introduction to Open sources, Need of Open Sources, Advantages of Open Sources and Application of Open Sources.

UNIT - II: LINUX

LINUX Introduction, General Overview, Kernel Mode and user mode, Process, Advanced Concepts-Personalities, Cloning, Signals.

UNIT - III: PHP

PHP- Introduction, Programming in web environment, variables, constants, data types, operators Statements, Arrays.

UNIT - IV: MySQL

MySQL: Introduction, Setting up account, Starting, terminating and writing your own SQL programs, Record selection Technology, Working with strings, Date and Time, Generating Summary, Working with metadata.

UNIT - V: Advanced PHP

OOP–String Manipulation, PHP and SQL database, PHP Connectivity, Debugging and error handling.

Text Books

1. M.N.Rao, "Fundamentals of Open Source Software", PHI Learning.
2. Steve Suchring,"MySQLBible", John Wiley, 2002

Reference Books

1. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", Wiley Publications, 2003.

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Open Elective - I

FUZZY MATHEMATICS

II Year – II Semester

Lecture : 3	Internal Marks : 30
Credits : 3	External Marks : 70

Course Objectives

- To impart the knowledge of fuzzy set theory and its applications in Engineering.

Course Outcomes

Upon successful completion of the course, the students will be able to

- state the need and applications of open source software.
- distinguish between crisp set and fuzzy set.
- know different operations on fuzzy relations.
- use defuzzification methods to crisp sets.
- draw inferences using fuzzy logic.
- develop membership value assignments.

Course Content

UNIT - I: Classical Sets And Fuzzy Sets

Classical sets – Operations – Properties. Fuzzy sets – Operations – Properties – membership functions - Features of the membership function.

UNIT - II: Fuzzy Relations

Fuzzy Cartesian product and composition - Fuzzy relations - Operations - Properties of fuzzy relations - Fuzzy tolerance and equivalence relations.

UNIT - III: Fuzzification And Defuzzification

Fuzzification - defuzzification to crisp set - Defuzzification to scalars (centroid method, centre of sums method, mean of maxima method).

UNIT - IV: Fuzzy Logic

Classical logic – Fuzz logic – Approximate reasoning ["if ... then" approach and "if ... then ....else" approach] – Other forms of the implication operation.

UNIT - V: Development Of Membership Functions

Membership value assignments – Inference – Rank ordering – Neural networks – Genetic algorithms – Inductive reasoning.

Text Books

1. Timothy J.Ross., Fuzzy Logic with Engineering Applications - Second Edition, Wiley Publications, 2015, New Delhi.

2. S.Rajasekaran, G.A.Vijayalakshmi Pai, Neural networks, Fuzzy logic, and genetic algorithms synthesis and applications- – Prentice-Hall of India private limited, 2008, New Delhi.

Reference Books

1. H.J. Zimmarman, Fuzzy set theory and its applications, 4th edition — Springer, 2013. New Delhi.
2. S.Nanda and N.R.Das "Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi.

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Professional Elective - I

ADVANCED STRENGTH OF MATERIALS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impact the knowledge on classification of cylinders based on their thickness and familiarize the stresses induced in thin and thick cylinders.
- To impart concepts on various theories of failures and unsymmetrical bending in beams.
- To familiarize with principles of analyzing cables, suspension bridges and plastic theory

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the thin and thick cylinders elastically.
- explain the failure theories.
- determine the stresses due to unsymmetrical bending.
- analyze cable and suspension bridge structures.
- analyze portal frames using slope deflection method.
- determine shape factors and plastic moment of resistance for simple beams and frames

Course Content

UNIT - I: Thin and Thick Cylinders

Thin Cylindrical Shells: Derivation for equations of longitudinal and hoop stresses - Hoop, Longitudinal and Volumetric strains – changes in diameter and volume of thin cylinders – efficiency of a joint.

Thick Cylinders: Stresses in thick cylinders and compound cylinders – Lame's theory of thick cylinders - Distribution of hoop and radial stresses across thickness of cylinder – Design of thick cylinders – Initial difference of radii for shrinkage.

UNIT - II: Theories of Failures

Introduction – Various Theories of failures like Maximum Principal Stress theory – Maximum Principal Strain theory – Maximum shear stress theory – Maximum strain energy theory – Maximum shear strain energy theory.

UNIT - III: Unsymmetrical Bending

Introduction – Centroidal principal axes of section — Moment of inertia referred to any set of rectangular axes – Stresses in beams subjected to unsymmetrical bending – Principal axes – Resolution of bending moment into two rectangular axes through the centroid – Location of neutral axis .

UNIT - IV: Cables and Suspension Bridges

Introduction to cables, analysis of cables subjected to concentrated and uniformly distributed loads, anchor cables, temperature effects, analysis of simple suspension bridge, three and two hinged stiffening girders.

UNIT - V: Portal Frames- Slope Deflection Method

Introduction, slope-deflection equations and application to rigid plane portal frames with and without sway subjected to UDL and point loads.

UNIT - VI: Plastic Analysis of Structures

Plastic moment of resistance - Plastic Modulus - Shape factor - Load factor - Plastic Hinge and mechanism – plastic collapse, lower and upper bound theorems, analysis of indeterminate beams and single bay single storey portal frames subjected to point load and UDL.

Text Books

1. Strength of Materials, R.K Bansal, 6^{th} edition 2017, Lakshmi Publications.
2. Analysis of Structures: Theory & Design Vol II, V N Vazirani ,4^{th} edition – 2009, Vikas Publications.

Reference Books

1. Strength of Materials, Ramamrutham, 6th edition 2017, Dhanapatrai son's publications.
2. Structural Analysis-II, S.S. Bhavikatti, 4th Edition -2015, Vikas Publications.
3. "Structural Analysis, A Matrix Approach" Pandit .G.S., Gupta .S.P, 2nd Edition, Tata McGraw-Hill Education, 2010.

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Professional Elective - I

GIS AND GPS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

- To introduce spatial information technology fundamentals.
- To narrate the progress from analog to digital spatial decision support systems
- To elaborate the applications of GPS in surveying

Learning Outcomes

Upon successful completion of the course, the students will be able to

- recall and recite the history of development of mapping.
- outline the structure of Geographic Information Systems and explain the interaction of various elements.
- identify and explain various tasks involved in building a GIS Database.
- analyse the differentiate between Raster and Vector data models and their applications.
- illustrate the general architecture of (SBNS) satellite based navigation systems.
- list the various SBNS platforms such as NAVSTAR, GLONASS, NAVIC, GALILEO, BEIDOU.

Course Content

UNIT - I: Digital Cartography

Maps: basic characteristics of maps, types of maps, classified by scale, function and subject matter – Map scale, representation of scale on maps, geographic coordinates, latitudes & longitudes – Map projections: planar, cylindrical, conical, conformal – Geoids and their representation.

UNIT - II: Structure of GIS

GIS data models & input devices: Raster data models, Vector data models, reference frameworks and transformation – Map preparation and the digitizing process, methods of vector input, methods of raster Input – External Databases – Principles of GIS.

UNIT - III: Data Storage and Editing

Storage formats of GIS Database, editing the GIS database, detecting and editing errors of different types of data, Edge Matching, Conflation and Rubber Sheeting, Templating.

UNIT - IV: Applications of GIS

Components of GIS, Raster & Vector Overlay Analysis – Network Analysis – Three dimensional representations using Digital Terrain Models (DTM) – TIN (Triangulated Irregular Network)

UNIT - V: Structure of GPS

Satellite System: GPS - Different segments – space, control and user segments – Satellite configuration – GPS signal structure – Orbit determination and Orbit representation, Anti spoofing and Selective availability – Task of control segment – GPS receivers – Main receiver components. Introduction to DGPS (Differential GPS) – DGPS vs GPS

UNIT - VI: Applications of GPS

Surveying with GPS: Introduction, planning a GPS Survey, surveying procedure – Engineering applications and monitoring – GPS and GLONASS constellations, configuration comparision – Satellite Laser Ranging & Applications – Concepts of satellite altimetry, Introduction to GALILEO, NAVIC, BEIDOU.

Text Books

1. Remote Sensing and GIS, Basudeb Bhatta, 2nd Edition, Oxford University Press.
2. Global Positioning System – Principles and Applications, Santheesh Gopi., (2005), Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books

1. GPS satellite surveying, Alfred Leick, 3rd Edition, 2004. John Wiley & Sons Inc.
2. Remote Sensing and Geographical Information system, A.M. Chandra and S.K. Ghosh, 2nd edition (2015), Narosa Publishing House, New Delhi.
3. GPS, B. HofmannWellenhof, H. Lichtenegger, and J. Collins, 5th revised edition, Springer Wien - New York.

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Professional Elective - I

GREEN BUILDINGS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce students to the concept of 'Green' Building.
- To familiarize students with the 'voluntary environmental building rating systems' (VERS) operating in India.
- To communicate the logic behind the rating categories in IGBC, GRIHA, LEED, EDGE, and WELL rating systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- highlight the unique features of green buildings.
- suggest the most appropriate building materials and fittings for green buildings.
- identify opportunities for energy and water savings in building energy and material flows.
- propose renewable energy utilisation options specific to the building project.
- enumerate occupant comfort parameters and suggest suitable electro-mechanical systems.
- guide project proponents to get green certification for buildings.

Course Content

UNIT - I: Suitable Site Selection

Typical features of Green Buildings, benefits of green buildings – Sustainable Site Selection, maximising comfort, integration of daylight, optimising ventilation; rainwater harvesting, recharge, reuse strategies

UNIT - II: Appropriate Materials

Renewable Materials, FSC (Forest Stewardship Council) certification – Rapid Renewal, bamboo, eucalyptus, poplar, rubberwood, linoleum – Low energy walling; rammed earth, stabilised mud, Adobe–Post Consumer, Post Industrial Waste recycling – Hollow blocks, lime, pozzolona cements, agri residues – Ferro cement, Ferro concrete – Alternative roofing systems; Vaults, Domes High albedo paints

UNIT - III: Water & Energy Conservation in Buildings

Need for energy conservation in buildings, various forms of energy used in buildings, embodied energy of materials, energy used in transportation and construction processes – Water Conservation systems in Buildings, water harvesting in buildings, waste to energy in residential complexes, Modular wastewater treatment systems

UNIT - IV: Net – Zero Energy Buildings

Wind Energy Concepts, wind energy potential and status in India, wind energy technologies – Solar Energy Concepts, solar energy potential and status in India, solar energy technologies, building scale applications and case studies - Building-scale hybrids.

UNIT - V: Indoor Environment Quality

Weather data collection, temperature, humidity, wind speed, direction–Climate change and Built Environment, how they affect each other – Occupant Comfort,design, codes, thermal comfort, lighting comfort, acoustic comfort - Mechanical Ventilation and Air Conditioning concepts – Energy Efficient Lighting Design – Passive cooling strategies, green roofs – Case studies from actual buildings

UNIT - VI: Measuring Sustainability 'voluntary environmental building rating Systems'

LEED Introduction, process, rating system, variants and levels–GRIHA Introduction, process, rating system, variants and levels– IGBC Introduction, process, rating system, variants and levels– Building Automation and BMS

Text Books

1. Alternative Building Materials and Technologies, K.S.Jagadish, B.V.Venkatarama Reddy and K.S.Nanjunda Rao, 2nd Edition, New Age International
2. Non-Conventional Energy Resources, G.D.Rai, 6th Edition, Khanna Publishers
3. GRIHA Manual and Reference Guides
4. LEED Reference Guides
5. IGBC Reference Guides

Reference Books

1. Sun, Wind, and Light: Architectural Design Strategies, Mark DeKay, G.Z.Brown, 3rd Edition, John Wiley & Sons
2. National Building Code of India (2016), Bureau of Indian Standards.

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Professional Elective - I

CONSTRUCTION MANAGEMENT

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the importance of management in construction projects.
- To familiarize with quality, safety and material management in construction projects.
- To explore environmental issues in construction project.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- illustrate the knowledge of organizing system and importance in business organisation.
- apply the quality control tools in various construction projects
- manage work men and materials in construction project
- adopt the health and safety measures in construction works
- make use of project case studies.

Course Content

UNIT - I: Organizing for Construction

General principles of forming an organization system, Importance of organization, types of organization, Forms of business organization

UNIT - II: Quality Control

Quality Control ,Importance of quality; Elements of quality; Organization for quality control; Quality assurance technique; Documentation; Quality control circles; (TQM) Total quality management; ISO – 9000s.

UNIT - III: Managing Projects

Project Review – Project Completion & Handover – Long term Project audit and review – Continuous improvement technique – Bench Marking of Performance and Process – The role of Project Leaders in the World Class Projects.

UNIT - IV: Materials Management

Importance, Objective, Functions of Material Management Department, stores management, Material procurement, Materials Handling

UNIT - V: Health & safety

(H&S) Health &Safety Management , Accident prevention programme; Immediate attention in case of accident; Approaches for safety improvements in construction; Safety benefits to employers, employees and customers; Prevention of fires in construction industries; Fault free analysis; Safety information system; Safety budgeting, case studies of H&S projects.

UNIT - VI: Case Studies

Environmental issues in construction- Hydel Power Projects, Thermal Power Projects, Nuclear Power Projects, and Factors to be considered in planning for big projects.

Text Books

1. Construction Engineering and Management, Dr. S. Seetharaman, Umesh Publications, 5th Edition, NaiSarark, Delhi.
2. Construction Planning, Equipment and Methods, Peurifoy and Schexnayder, Shapira, Tata Mcgrawhill.

Reference Books

1. Construction Project Management - An Integrated Approach, Peter Fewings , Taylor and Francis.
2. Construciton Management Emerging Trends and Technologies, Trefor Williams, Cengage learning.

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Open Elective - II

GEOINFORMATICS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course objectives

- To introduce the basic concepts and principles of remote sensing.
- To familiarize with structure and function of Geographic Information Systems.
- To illustrate the multidisciplinary nature of Geospatial applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- relate the scientific theories to the behaviour of electromagnetic spectrum.
- distinguish between different types of satellites and identify appropriate remote sensing data products for mapping, monitoring and management applications.
- interpret Satellite images and processed outputs for extracting relevant information.
- structure the concept of a spatial decision support system in its analog and digital forms.
- perform tasks related to building a GIS database with location, attribute and meta-data.
- list and elaborate applications of Geoinformatics in various fields.

Course Content

UNIT - I: Electro-Magnetic Radiation (EMR), its interaction with Atmosphere & Earth

Definition of remote sensing and its components – Electromagnetic spectrum, wavelength regions important to remote sensing, wave theory, particle theory, Stefan-Boltzmann and Wien's Displacement Law – Atmospheric scattering, absorption, atmospheric windows, spectral signature concepts, typical spectral reflective characteristics of water, vegetation and soil.

UNIT - II: Platforms and Sensors

Types of platforms, orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors, resolution concept, payload description of important Earth Resources and Meteorological satellites – Airborne and Space-borne TIR (Thermal Infrared Radiation) and microwave sensors.

UNIT - III: Image Interpretation and Analysis

Types of Data Products – types of image interpretation, basic elements of image interpretation, visual interpretation keys – Digital Image Processing, pre-processing, image enhancement techniques – multispectral image classification, supervised and unsupervised

UNIT - IV: Geographic Information System

Introduction to Maps, definitions, map projections, types of map projections, map analysis – GIS definition, basic components of GIS, standard GIS software's – Data types, spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems(DBMS).

UNIT - V: Data Entry, Storage and Analysis

Data models, vector and raster data – data compression – data input by digitisation and scanning – attribute data analysis – integrated data analysis – modelling in GIS for scenario analysis and planning.

UNIT - VI: RS and GIS Applications

Land cover and land use, agriculture, forestry, urban applications, hydrology, flood zone delineation & mapping, groundwater prospects & recharge, reservoir storage estimation.

Text Books

1. Remote Sensing and Geographical Information Systems, M.Anji Reddy, 4th Edition, B.S.Publications.
2. Remote Sensing and GIS, Basudeb Bhatta, 2nd Edition, Oxford University Press.

Reference Books

1. Remote Sensing and Image Interpretation, Lillesand, T.M, R.W. Kiefer and J.W. Chipman , 7th Edition (2015), Wiley India Pvt. Ltd., New Delhi
2. Remote Sensing Digital Image Analysis, Richard, John A, 5th Edition (2014), Springer.

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Open Elective - II

ENVIRONMENTAL SANITATION

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To communicate the importance of institutional sanitation in maintaining public health.
- To introduce the strategies for maintaining healthy living and working environment.
- To delineate the role of environmental engineer in industrial environments.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the common communicable diseases and the solutions for controlling them.
- suggest appropriate sanitation measures for water supply and sanitation in un-sewered areas.
- describe the process of refuse disposal in rural areas.
- draw out the procedures adopted for maintaining hygiene in institutional buildings.
- list out the occupational comfort parameters to be considered for designing built environment.
- introduce the notion of occupational health, safety and the related management approaches.

Course Content

UNIT - I: Epidemics, Epizootics

Origin and spread of Communicable diseases like Cholera, Smallpox, Tuberculosis, Malaria, Filaria, and Plague, common methods (nose, throat, intestinal discharges) – Role of Public Health Engineering in the preventive aspects of the above diseases –Role of vectors in transmitting diseases and Rodent control methods.

UNIT - II: Rural water supply and Sanitation

Sanitary protection of wells, springs, economic methods of treatment – Excreta disposal systems – Types of sanitary privies.

UNIT - III:Refuse Sanitation

Quality and quantity of garbage, rubbish, ashes, street sweepings, night soil; methods of conveyance and sanitary disposal methods, latest technologies adopted to dispose off the solid wastes.

UNIT - IV: Food Hygiene and Sanitation

Milk and milk products, sanitary maintenance of catering, establishment, measures – Sanitary requirements and maintenance of the public utility services like schools, hospitals, offices and in other public buildings.

UNIT - V:Ventilation, Air Conditioning And Light

Composition of ambient air, air pollutants, bacteria, odours – Effective Temperature – Comfort standards of ventilation, air interchange, natural ventilation, artificial ventilation, air conditioning – Measurement of light, illumination standards, natural lighting, artificial lighting.

UNIT - VI: Occupational Health and Safety

Occupational hazards in public buildings, schools, hospitals, eating establishments, swimming pools – Cleanliness and maintenance of comfort – Industrial plant sanitation – OHSAS 18001 and the WELL Building Standard and rating for built environment.

Text Books

1. Municipal and Rural Sanitation, Victor M.Ehlers, Ernest W. Steel, 6th Edition, McGraw Hill
2. Environmental Sanitation, Joseph A. Salvato, Nelson L. Nemerow, Franklin J. Agardy , 5th Edition, John Wiley and Sons
3. OHSAS 18001 Manual
4. WELL Rating System Manual

Reference Books

1. Integrated Solid Waste Management, George Tchobanoglous, Hilary Theisen, Samuel A Vigil,McGraw Hill.
2. Not in my backyard – Solid Waste Management in Indian Cities, Sunita Narain, Jain Book Agency.
3. National Building Code of India, Bureau of Indian Standards.

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Open Elective - II

MODELING AND SIMULATION OF ENGINEERING SYSTEMS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with programming skills using basic MATLAB and its associated tool boxes.
- To impart knowledge on building SIMULINK and Graphical user interface.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- develop MATLAB programme for the solution of engineering system.
- build a SIMULINK model and GUI to simulate engineering system and asses its performance.
- solve and visualize the dynamic performance of engineering systems through MATLAB tool boxes.
- compute and analyse the data of a physical system using advanced programming methods in MATLAB.

Course Content

UNIT - I: Variables, scripts, and operations

Getting Started, Scripts, Making Variables, Manipulating Variables, Basic Plotting

UNIT - II: Visualization and programming

Functions, Flow Control, Line Plots, Image/Surface Plots, Vectorization

UNIT - III: Solving equations and curve fitting

Linear Algebra, Polynomials, Optimization, Differentiation/Integration, Differential Equations

UNIT - IV: Advanced methods

Probability and Statistics, Data Structures, Images and Animation, Debugging, Online Resources

UNIT - V: Symbolics, Simulink®, file I/O, building GUIs

Symbolic Math, Simulink, File I/O, Graphical User Interfaces

UNIT - VI:

Examples on statistics, optimization, plots.

Text Books

1. "Getting started with MATLAB" by Rudra pratap, Oxford University, 2002.
2. MATLAB and SIMULINK for Engineers by Agam Kumar Tyagi, OUP 2011

Reference Books

1. Spencer, R.L. and Ware, M (2008), Introduction to MATLAB, Brigham Young Unviersity, available online, accessed, 7, 2008.
2. David F.Griffiths, October (2012) "An introduction to MATLAB" the Unviersity of Dundee, available online, Acessed, October 2012.

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Open Elective - II

POWER SYSTEMS ENGINEERING

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the working of power plants in power generation and layout of substations.
- To familiarize with the concepts of corona, insulators and sag in overhead lines.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe the operation of thermal power station.
- describe the operation of nuclear and hydel power plants.
- distinguish various bus bar arrangements in substation
- analyze the phenomenon of corona.
- determine the sag in over head lines

Course Content

UNIT - I: Thermal Power Stations

Single line diagram of Thermal Power Station showing paths of coal, steam, water, air, ash and flue gasses-Brief description of TPS components: Economizers, Boilers, super heaters, Turbines ,condensers, chimney and cooling towers.

UNIT - II: Nuclear Power Stations

Working principle, Nuclear fuels. Nuclear reactor Components: Moderators, Control roads, Reflectors and Coolants. Types of Nuclear reactors and brief description of PWR, BWR and FBR.

UNIT - III: Hydal power stations

Selection of site, block diagram approach of hydro electric power plant and classification of pumped storage power plants.

UNIT - IV: Air insulated substations

Equipments used in substations, Classification of substations: - Indoor & Outdoor substations: Single line diagram of substation. Bus bar arrangements and their classification.

UNIT - V : Overhead Line Insulators and Corona

Types of Insulators, String efficiency and methods for improving string efficiency, Corona - Description of the phenomenon, factors affecting corona, critical voltages and power loss.

UNIT - VI: Sag and Tension Calculations

Sag and Tension calculations with equal and unequal heights of towers, effect of Wind and Ice on weight of Conductor, Stringing chart and sag template and its applications.

Text Books

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd., 1999.

Reference Books

1. Principles of Power Systems by V.K Mehta and Rohit Mehta S.Chand& Company Ltd.New Delhi 2004.
2. Electrical Power Systems by C.L.Wadhawa New age International (P) Limited, Publishers 1997.
3. Electrical Power Generation, Transmission and Distribution by S.N.Singh., PHI, 2003.

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Open Elective - II

ELEMENTS OF MECHANICAL TRANSMISSION

III Year – I Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize with the principles of mechanical power transmission elements

Learning Outcomes

Upon successful completion of the course, the students will be able to

- Identify suitable shaft couplings for a given application.
- describe various transmission elements like belts, ropes and chain drives.
- Explain different thread profiles and applications of power screws
- explain the working of various gears, gear trains and gear box.

Course Content

UNIT - I: Shaft Couplings

Shaft couplings: Rigid couplings – Muff, split muff and flange couplings, Flexible coupling-Modified Flange coupling

UNIT - II: Belt Drives

Flat Belts: Introduction, Selection of a Belt Drive, Types of Belt Drives, Length of Belts, Materials, Belt Joints, Types of Flat Belt Drives, Power transmitted.

UNIT - III: V-Belt, Rope Drives & Chain Drives

V-belts: Introduction, Types of V-belts, Ratio of Driving Tensions for V-belt, Power transmitted.

Rope Drives: Introduction, Classification of rope drives, Power transmitted

Chain drives: Introduction, Chain drives, Polygonal effect, Selection of roller chains, length of chain.

UNIT - IV: Power Screws

Forms of Threads, Multi-start Threads, Right Hand and Left Hand Threads, nut, compound screw, differential screw

UNIT - V: Gears and Gear trains

Types, terminology, materials, law of gearing, velocity of sliding, forms of teeth, path of contact, arc of contact, interference, Gear Trains - Types, differential of an automobile.

UNIT - VI: Gearbox

Introduction, types, constant mesh gearbox, sliding type gear box, single and multi stage gear box

Text Books

1. Design of machine elements by Bhandari, Tata McGraw Hill book Co.3rd Edition,2010.
2. Machine Design by P.C. Sharma & D.K. Agarwal. 4th Edition-1996.S.K.Kataria & Sons

Reference Book

1. Design of Machine Elements by Sharma & Purohit ,PHI, 10th Edition,2011.
2. Design of Machine Elements by Kannaiah.5th Edition,1999.Scitech Publication.

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Open Elective - II

MATERIAL HANDLING EQUIPMENT

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To provide knowledge on materials handling equipment.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the basic concepts of material handling equipments.
- illustrate the working principle of conveyors, industrial trucks, hoppers, hoists and cranes.

Course Content

UNIT - I: Introduction

Types of industrial transport – classification and characteristics of materials – classification and selection of materials handling.

UNIT - II: Conveyor Equipment

Classification of conveyors – description and uses of belt – conveyors – apron conveyors -Roller conveyors – water – screw conveyors – pneumatic and hydraulic conveyors, Computer controlled conveyor system.

UNIT - III: Industrial Trucks

Industrial trucks – main types – purpose of hand trucks – tractors and trailers – self propelled trucks – fork trucks , Automated guided vehicles.

UNIT - IV: Auxiliary Equipment

Hoppers and gates – uses, auxiliary equipment – feeders – chutes – uses.

UNIT - V: Hoisting Appliances

types, description and uses of chain – ropes – types and description and purpose of crane hooks – Grab buckets, lifts – excavators.

UNIT - VI: Cranes

Hand-propelled and electrically driven E.O.T overhead Traveling, cranes; Traveling mechanisms of cantilever and monorail cranes.

Text Books

1. Conveyor Equipment Manufacturer's Association, "*Belt conveyors for bulk materials*" 6th edition, The New CEMA Book.
2. Rudenko N., "*Materials handling equipment*", Elnvee Publishers, 1970
3. Ishwar G Mulani and Mrs. Madhu I Mulani, "*Engineering Science and application design for belt conveyor*", Madhu I. Mulani, 2002.

Reference Books

1. Spivakovsy A.O. and Dyachkov V.K., "*Conveying Machines, Volumes I and II*", MIR Publishers, 1985.
2. Alexandrov, M., "*Materials Handling Equipments*", MIR Publishers, 1981.
3. Boltzharol, A.,"*Materials Handling Handbook*", The Ronald press company 1958.

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Open Elective - II

AUTOMOTIVE ELECTRONICS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the electronic systems inside an automotive vehicle.
- To introduce the concepts of advanced safety systems

Learning Outcomes

Upon successful completion of the course, the students will be able to

- learn the fundamentals of automotive technology.
- describe the operation of microcomputer systems.
- acquire knowledge in automotive sensors and control systems.
- develop communications & navigation/routing in automotive vehicles.

Course Content

UNIT - I: Automotive Fundamentals

Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.

UNIT - II: Automotive Micro-Computer System

Binary number system, binary counters, Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory-ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram.

UNIT - III: Basics of Electronics Engine Control

Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.

UNIT - IV: Sensors and Actuators

Introduction; basic sensor arrangement; types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, actuators – fuel metering actuator, fuel injector, and ignition actuator.

UNIT - V: Electronic Vehicle Management System

Cruise control system, antilock braking system, electronic suspension system, electronic steering control, and transmission control, safety: air bags, collision avoidance radar warning system with block diagram, low tire pressure warning system, advanced cruise control system.

UNIT - VI: Automotive Instrumentation System

Speech synthesis, sensor multiplexing, control signal multiplexing with block diagram, fibre optics inside the car, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialling.

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", SAMS/Elsevier Publishing, 6th Edition. (UNIT I to VI).
2. Robert Bosch Gambh, "Automotive Electrics Automotive Electronics Systems and Components", John Wiley& Sons Ltd., 5th edition, 2007.

Reference Books

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications", Springer, 2009.
3. Robert Bosch, "Automotive Hand Book", SAE, 5th Edition, 2000.

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Open Elective - II

INTRODUCTION TO MEMS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce lithography principles, mechanical sensors and actuators.
- To make it known the thermal sensors and actuators, magnetic sensors and actuators.
- To present formally micro fluidic systems and chemical and bio medical micro systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- define MEMS, lithography methods, sensors and actuators.
- describe the principles of MOEMS technology and its applications.
- elucidate different magnetic sensing and detection for MEMS.
- apply sensing principles and mechanisms the chemical and bio medical micro systems.

Course Content

UNIT - I: Introduction

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

Mechanical Sensors and Actuators: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT - II: Thermal Sensors and Actuators

Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT - III: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT - IV: Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT - V: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, optoelectro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

UNIT - VI: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

Text Book

1. Nitaigour Premchand Mahalik "MEMS", TMH Publishing co.

Reference Books

1. Chang Liu "Foundation of MEMS", Prentice Hall Ltd.
2. Sergey Edwrd Lyshevski "MEMS and NEMS", CRC Press, Indian Edition.
3. Tai-Ran Hsu "MEMS and Micro Systems: Design and Manufacture", TMH Publishers.
4. Richard A Layton, Thomas M Adams "Introductory MEMS", Springer International Publishers.

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Open Elective - II

DATA SCIENCE

III Year – I Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize with statistical methods to analyze data using classification, graphical and computational methods
- To introduce Data Wrangling approaches and descriptive analytics on large data sets.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply statistical methods to data for inferences.
- analyze data using Classification, Graphical and computational methods.
- describe Data Wrangling approaches.
- perform descriptive analytics over massive data.

Course Content

UNIT - I: Introduction and Linear Regression

Overview of random variables and distributions, statistical learning, assessing model accuracy, descriptive statistics, dependent and independent events

Linear Regression: Simple and multiple linear regressions, comparison of linear regression with k-nearest neighbors.

UNIT - II: Hypothesis Testing

Simple Hypothesis testing, student's t-test, paired t and u test, correlation and covariance, tests for association.

UNIT - III: Graphical Analysis

Histograms and frequency polygons, box-plots, quartiles, scatter plots, heat maps.

UNIT - IV: Computational Methods

Programming for basic computational methods such as Eigen values and Eigen vectors, sparse matrices, QR and SVD.

UNIT - V: Data Wrangling

Data acquisition, data formats, imputation, the split-apply-combine paradigm.

UNIT - VI: Descriptive Analytics

Data warehousing and OLAP, data summarization, data de-duplication, data visualization using CUBEs.

Text Book

1. Gareth James, Trevor Hastie, Robert Tibshirani, Daniela Witten, "An Introduction to Statistical Learning with Applications in R".

Reference Book

1. Mark Gardener, "Beginning R The statistical Programming Language", Wiley.

Web link

www.statlearning.com

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Open Elective - II

VIRTUAL AND AUGMENTED REALITY

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce key elements of virtual Reality with the components in VR systems.
- To gain knowledge of various input and output devices required for interacting in virtual world and augmented reality.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify basic elements of virtual reality
- describe various input and output devices required for VR experience
- classify human factors that affect VR experience
- distinguish augmented reality from virtual reality
- express the object position and orientation in virtual space.

Course Content

UNIT - I: Introduction

The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.

UNIT - II: Input Devices

Trackers, Navigation, and Gesture Interfaces: Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces.

UNIT - III: Output Devices

Graphics displays, sound displays and haptic feedback.

UNIT - IV: Human Factors

Methodology and terminology, user performance studies, VR health and safety issues. Applications: Medical applications, military applications, robotics applications.

UNIT - V: Augmented Reality

Introduction - head-up displays, helmet-mounted sights and displays, smart glasses and augmenting displays

UNIT - VI: Understanding Virtual Space

Visual and object space, defining position and orientation in three dimensions.

Text Books

1. John Vince, "Virtual Reality Systems", Pearson Education.
2. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", Addison-Wesley.

Reference Books

1. Brett S. Martin, "Virtual Reality", Norwood House Press, 2017.
2. Alan B. Craig, "Understanding Augmented Reality: Concepts and Applications", Newnes.

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Open Elective - II

OPEN SOURCE SOFTWARE

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the opportunities for open source software in the global market.
- To familiarize with different steps in implementing the open source.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- state the need and applications of open source software.
- compare and Contrast between Open source and commercial software
- demonstrate LINUX operating systems concepts.
- create database in MYSQL and perform operations on it.
- design and develop a web application using PHP.

Course Content

UNIT - I: Introduction

Introduction to Open sources, Need of Open Sources, Advantages of Open Sources and Application of Open Sources.

UNIT - II: LINUX

LINUX Introduction, General Overview, Kernel Mode and user mode , Process, Advanced Concepts - Personalities, Cloning, Signals.

UNIT - III: Open Source Programming Languages

PHP- Introduction, Programming in web environment, variables, constants, data types, operators Statements, Arrays.

UNIT - IV: Introduction to MySQL

MySQL: Introduction, Setting up account, Starting, terminating and writing your own SQL programs, Record selection Technology, Working with strings, Date and Time.

UNIT - V: Working with MySQL

Sorting Query Results, Generating Summary, Working with metadata, Using sequences.

UNIT - VI: Advanced PHP

OOP – String Manipulation, PHP and SQL database, PHP Connectivity, Debugging and error handling.

Text Books

1. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", WileyPublications,2003.
2. Steve Suchring, "MySQL Bible", John Wiley, 2002

Reference Books

1. RasmusLerdorf and Levin Tatroe, "Programming PHP", O'Reilly, 2002.
2. Steven Holzner, "PHP: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
3. VikramVaswani, "MYSQL: The Complete Reference", 2nd Edition, TataMcGraw –Hill Publishing Company Limited, Indian Reprint 2009.

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Open Elective - II

CYBER LAWS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To expose the need of cyber laws to prosecute cybercrimes in the society.
- To familiarize with Licensing Issues Authorities for Digital Signatures.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the pros and cons of Internet.
- operate on confidential data in a precautious manner.
- discuss Criminal Justice in India and its Implications.
- interpret the Cyber Consumers under the consumer Protection Act.
- devise the legal framework for Confidential Information.
- determine the e-commerce issues for copyright protection and defend personal data from being hacked.

Course Content

UNIT - I: The IT Act, 2000- A Critique

Crimes in this Millennium, Section 80 of the IT Act, 2000 – A Weapon or a Farce?,Forgetting the Line between Cognizable and Non - Cognizable Officers, Arrest for"About to Commit" an Offence Under the IT Act, A Tribute to Darco, Arrest But NoPunishment.

UNIT - II: Cyber Crime and Criminal Justice

Penalties, Adjudication and Appeals Under the IT Act, 2000: Concept of CyberCrime and the IT Act, 2000, Hacking, Teenage Web Vandals, Cyber fraud andCyber Cheating, Virus on Internet Deformation, Harassment and E- mail Abuse

UNIT - III: Cyber Criminality Strategies and Trends

Network Service Providers, Jurisdiction and CyberCrimes, Nature of Cyber Criminality Strategies to Tackle Cyber Crime and Trends,Criminal Justice in India and Implications.

UNIT - IV: Digital Signatures, Certifying Authorities and e-Governance

Introduction to Digital Signatures, Certifying Authorities and Liability in the Eventof Digital Signature compromise, E - Governance in the India. A Warming toBabudom, Are Cyber Consumers Covered under the Consumer Protection, Goodsand Services, Consumer Complaint Defect in Goods and Deficiency in ServicesRestrictive and Unfair Trade Practices

UNIT - V: Traditional Computer Crime

Early Hacker and Theft of Components Traditional problems, Recognizing andDefining Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computersas Commodities, Theft of intellectual Property.

UNIT - VI: Web Based Criminal Activity

Interference with Lawful Use of Computers, Malware, DoS (Denial of Service) andDDoS (Distributed Denial of Service) Attacks, Spam ,Ransomware and Kidnappingof Information, Theft of Information, Data Manipulation, and Web EncroachmentOnline Gambling Online Fraud, Securities Fraud and stock Manipulation, Ancillarycrimes

Text Books

1. Vivek Sood, " Cyber Law Simplefied", Tata McGraw Hill.
2. Marjie T. Britz, "Computer Forensics and Cyber Crime", Pearson

Reference Book

1. Cyber Laws Texts and Cases, Ferrera, CENGAGE.

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Open Elective - II

QUALITY, RELIABILITY AND OPERATIONS RESEARCH

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To equip students with basic practical skills with sufficient theory.
- To understand the principles involved in the application area.
- To develop the power of systematic thinking and reasoning, practical approach and exposition in the students.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- Construct the control charts to understand whether the process is under control.
- Solve various problems regarding quality and life testing of a given product(s).
- Form the real life situations/practical problems into LPP.
- Apply various algorithms like graphical method, simplex method, Charne's method, Hungarian method etc.
- Find the optimal Transportation cost and optimal assignment policy.
- Appreciate Travelling Salesman Problem.
- Identify the job sequence to the given situation and to find the total elapsed time.

Course Content

UNIT - I: Statistical Process Control

Importance of Statistical Quality Control (SQC) in industry, Statistical basis of Shewart Control Charts, Construction of control charts for variables and attributes (with fixed and varying sample sizes), Interdependence of control charts, Natural tolerance limits and specification limits, process capability index, concept of Six sigma and its importance.

UNIT - II: Accepting Sampling Plans

Producer's Risk and Consumer's Risk, Concept of AQL and LTPD. Single and Double Sampling plans for attributes and derivation of their OC and ASN functions, design of single and double sampling plans for attributes using Binomial distribution.

UNIT - III: Reliability

Introduction, Hazard function, Exponential distribution as life model, its memory less property, Reliability function and its estimation, concepts of censoring and truncation, system reliability - series, parallel and k out of N systems and their reliabilities.

UNIT - IV: Linear Programming

Meaning and scope of OR, Convex sets and their properties. Definition – general LPP, formulation of LPP, solution of LPP by Graphical method, Simplex algorithm, concept of degeneracy and resolving it, concept of duality , duality as LPP, Dual-Primal relationships.

UNIT - V: Transportation Problem

Definition of Transportation problem(TP) – TP as a special case of LPP, Feasible solutions by North-west corner rule, Matrix minima method, Vogel's Approximation method. Optimal solution through MODI tableau method for balanced and unbalanced TPs. Degenercy in TP and resolving it.

UNIT - VI: Assignment and Sequencing Promlems

Description of Assignment problem(AP) and its variations, AP as a special case of TP and LPP (both balanced and unbalanced cases), Optimum solution by Hungarian method. Travelling salesman problem.

Introduction to Sequencing problem, optimum sequence of N jobs on two an three machines (without passing).

Text Books

1. Kanti Swaroop, P. K. Gupta and Man Mohan: Operations Research, Sultan Chand Company.
2. L. S. Srinath: Reliability Engineering, Affiliated East-West Press.
3. Parimal Mukhopadhyay: Applied Statistics, New Central Book Agency.
4. Gass: Linear Programming, Mc Graw Hill.
5. R. C. Gupta: Statistical Quality Control.

Reference Books

1. V. K. Kapoor and S. C. Gupta: Fundamentals of Applied Statistics, Sultan Chand.
2. S. K. Sinha: Reliabilty and Life Testing
3. S. M. Ross: Probability Models, Harcourt India Pvt. Ltd.
4. D. C. Montgomory: Introduction to Statistical Quality Control, Wiley.
5. Hadly: Linear Programming, Addison – Wiley.
6. Taha: Operation Research: An Introduction, Mac Millan.
7. Wayne L. Wiston: Operations Research, Thomson, India edition, 4th Edition.

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Optional Elective - III

INFRASTRUCTURE DEVELOPMENT

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To evaluate infrastructure development.
- To know PPP Procurement Process in India.
- To manage the risks associated with various infrastructure projects.
- To identify the critical issues in infrastructure financing.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- PPP as a mechanism to attract private investment for development.
- risk identification, risk sharing and risk mitigation for PPP projects.
- contracting for and contract management of PPP contracts during their lives.
- financing instruments available for PPP projects.

Course Content

UNIT - I: Infrastructure Development – Introduction

Infrastructure Development and Economic Growth - Sources of Financing Infrastructure Projects - Limitations of Traditional Procurement Process.

UNIT - II: PPP – Overview

Infrastructure Development through PPP Route - Stakeholders' Perspectives - Governments Roles in Successful PPP Projects - Bidding Evaluation And Bidding Rules- Value For Money Assessment.

UNIT - III: PPP - Procurement Process

PPP Procurement Process - PPP Contractual Package - PPP Procurement Process in Indi.

UNIT - IV: Structuring a PPP: Available PPP Options

Service Contract - Management Contracts - Affermage or Lease Contracts- Concessions -Build–Operate–Transfer and Similar Arrangements -Joint Venture - Hybrid Arrangements

UNIT - V: Risk Management

Risks Associated With Various Infrastructure Projects - Risk Management - Risk Identification - Risk Assessment - Risk Allocation - Risk Mitigation - Risk Allocation Framework - PPP Road Projects in India

UNIT - VI: Project Finance

Introduction to Project Finance - Project Financing Process - Project Finance - Security Package - Preparing Financing Plan - Lending Institutions in India

Text Books

1. Public-Private Partnerships - Managing risks and opportunities, Akintoye, A., Beck, M., & Hardcastle, C. (Eds.). (2003), Oxford: Blackwell Science Limited.
2. Project financing - Asset-based financial engineering, Finnerty, J. D. (1996), New York: John Wiley & Sons, Inc.
3. Investment project design - A guide to financial and economic analysis with constraints, Kurowski, L., & Sussman, D. (2011), New Jersey: John Wiley & Sons.
4. Project finance for construction and infrastructure: Principles and case studies, Pretorius, F., Lejot, P., McInnis, A., Arner, D., & Hsu, B. F.-C. (2008), Oxford: Blackwell Publishing.

Reference Books

1. Infrastructure as an asset class - Investment strategies, project finance and PPP, Weber, B., & Alfen, H. W. (2010), West Sussex: John Wiley & Sons
2. Project Finance in Asia Pacific: Practical Case Studies, Tinsley, R. (2002). London, UK: Euromoney Books.
3. Guidelines for infrastructure development through Build-Operate-Transfer (BOT) projects, UNIDO. (1996), Vienna: UNIDO.
4. Privatized infrastructure: the Build Operate Transfer approach, Walker, C., & Smith, A. J. (1995), London: Thomas Telford.

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Optional Elective - III

BASICS OF POWER PLANT ENGINEERING

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the working principles of various power plants.

Learning Outcomes

Upon successful completion of the course , students will be able to

- identify the various conventional energy resources.
- explain the working principles of various power plants used in electric power generation.

Course Content

UNIT - I: Introduction

Energy and power, Sources of Energy Types of power plants and Development of Power in India.

UNIT - II: Steam Power Plant

Plant Layout, Components, Working of different Circuits, Coal Handling Systems,Ash handling systems.

UNIT - III: Gas Turbine Plant

Introduction, Types of Gas Turbine Plants, Layout with auxiliaries, Principles of working of Closed and Open Cycle Gas Turbines. Combined cycle Gas Turbine power plants, Cogeneration

UNIT - IV: Diesel power plant

Introduction- Plant layout with auxiliaries, Fuel supply system, Lubrication and Cooling system.

UNIT - V: Nuclear Power Station

Nuclear reactor- Reactor Operation,.Classification of Nuclear Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor.

UNIT - VI: Hydroelectric Power Plant

Classification of Hydroelectric Power Plants, Typical Layouts, Plant auxiliaries, Classification of dams and spill ways.

Text Books

1. An Introduction to Power Plant Technology, G.D. Rai, 3rd EditionKhanna Publishers, 2004,
2. Power Plant Engineering, P.K.Nag, 4th Edition, Tata McGraw-Hill Education, 2014.

Reference Books

1. A Course in Power Plant Engineering, S.C. Arora and S. Domkundwar, Dhanpat Rai & Co. (P) Limited, 2014
2. Power Plant Engineering, R. K. Rajput, 4th Edition, Laxmi Publications, New Delhi, 2016.
3. Power Plant Technology, M.M.El-Wakil, Revised 2nd edition, Tata McGraw-Hill Education.

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Optional Elective - III

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of object oriented programming.
- To impart the knowledge of AWT components in creation of GUI.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply Object Oriented approach to design software.
- create user defined interfaces and packages for a given problem.
- develop code to handle exceptions.
- implement multi tasking with multi threading.
- develop Applets for web applications
- design and develop GUI programs using AWT components.

Course Content

UNIT - I: Fundamentals of OOP and Java

Need of OOP, principles of OOP languages, procedural languages vs. OOP, Java virtual machine, java features.

Java Programming constructs: variables, primitive data types, identifiers, keywords, Literals, operators, arrays, type conversion and casting.

UNIT - II: Class Fundamentals and Inheritance

Class fundamentals, declaring objects, methods, constructors, this keyword, overloading methods and constructors, access control.

Inheritance- Basics, types, using super keyword, method overriding, dynamic method dispatch, abstract classes, using final with inheritance, Object class.

UNIT - III: Interfaces and Packages

Interfaces: Defining an interface, implementing interfaces, nested interfaces, variables in interfaces and extending interfaces.

Packages: Defining, creating and accessing a package.

UNIT - IV: Exception Handling and Multithreading

Exception Handling- exception-handling fundamentals, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, user-defined exceptions.

Multi Threading - Introduction to multitasking, thread life cycle, creating threads, synchronizing threads, thread groups.

UNIT - V: Applets and Event Handling

Applets- Concepts of Applets, differences between applets and applications, life cycle of an applet, creating applets.

Event Handling- Events, event sources, event classes, event listeners, Delegation event model, handling mouse and keyboard events, adapter classes.

UNIT - VI: AWT

The AWT class hierarchy, user interface components- label, button, checkbox, checkboxgroup, choice, list, textfield, scrollbar, layout managers –flow, border, grid, card, gridbag.

Text Books

1. Herbert Schildt, "Java The Complete Reference", 7th edition, TMH.
2. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", 2nd edition, Oxford.

Reference Books

1. Joyce Farrel, Ankit R.Bhavsar, "Java for Beginners", 4th edition, Cengage Learning.
2. Y.Daniel Liang, "Introduction to Java Programming", 7th edition, Pearson.
3. P.Radha Krishna, "Object Oriented Programming through Java", Universities Press.

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Professional Elective - II

ADVANCED STRUCTURAL ANALYSIS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with numerical methods of Engineering analysis
- To impart the knowledge on ILDs of three hinged arches.
- To familiarize with basic principles of matrix methods of structural analysis
- To introduce the basics of theory of elasticity

Learning Outcomes

Upon successful completion of the course, students will be able to

- adopt the methods for analysing engineering products.
- draw ILD for three hinged arches.
- analyze indeterminate trusses.
- apply concept of matrix methods for framed structures up to two degree of freedom.
- explain the principle of elasticity and stress strain relationships.

Course Content

UNIT - I: Engineering Analysis

Methods of engineering analysis-Introduction to experimental, Analytical and numerical methods, Variational method-Rayleigh-Ritz method, Concept of potential energy-Constituents of total potential energy, Strain energy, Stationary properties and variation characteristics of total P.E, Weighed residual methods - Point allocation method, Sub domain method, Least squares method, Galerkin's method.

UNIT - II: Three Hinged Arches

Introduction, Influence line diagrams-Three hinged arches - point loads and udl.

UNIT - III: Indeterminate Structural Analysis

Indeterminate Trusses -Determination of static and kinematic indeterminacies-Castigliono's theorem - Solution of trusses up to two degrees of internal and external indeterminacy.

UNIT - IV: Flexibility method of Analysis

Analysis of continuous beams with support settlement and rigid jointed plane frames with static indeterminacy not exceeding two.

UNIT - V: Stiffness method of Analysis

Analysis of continuous beams with support settlement and rigid jointed plane frames with kinematic indeterminacy not exceeding two.Direct formulation of stiffness matrix for plane frames with number of bays and stories not exceeding one.

UNIT - VI: Introduction to Theory of Elasticity

Introduction to theory of elasticity: Notations for forces and stresses, components of stresses and strains,plane stress, plane strain-definitions, differential equations of equilibrium-Hooke's Law

Text Books

1. Structural analysis, T.S. Thandavamoorthy, Oxford University press, New Delhi, 2011.
2. Introduction of finite element analysis by S.Md. Jalaludeen, Anuradha publications, 2011.
3. Theory of Elasticity, Timoshenko and Goodier, McGraw Hill Publishers, 2010.
4. Structural Analysis - A Matrix Approach, G Pandit , S. Gupta, McGraw Hill Publishers, 2008.

Reference Books

1. Theory of Structures, Ramamrutham, Dhanapatraisons publications, 2014.
2. Theory of Elasticity, Sadhu Singh, Khanna Publishers, New Delhi, 1998.
3. Structural analysis-I, S SBhavakatti, Vikas publishing house pvt ltd, 2011.
4. Analysis of structures Vol-I & Vol-II, V.N.Vazirani&M.M.Ratwani, Khanna PublishersNewDelhi 1994, 1999.

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Professional Elective - II

ENVIRONMENTAL POLLUTION AND ITS CONTROL

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts of Air Pollution and the control methods.
- To impart the knowledge of the Solid Waste generation problem.
- To familiarize the best practices for management of solid wastes adopted at the service provider level.
- To elucidate noise pollution problems and emphasize the necessity to control them.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- evaluate the ambient air quality based on the analysis of air pollutants.
- relate the polluting plume behaviour with weather data.
- identify suitable control methods depending on the severity and type of air pollution.
- classify solid wastes and identify suitable collection and transfer mechanisms.
- suggest suitable solid waste management methods based on the nature of solid waste and the quantities to be handled.
- identify the sources of noise pollution and suggest methods for mitigating the problem.

Course Content

UNIT - I: Air Pollution

Definitions, scope, significance and episodes – Types of pollutants, their sources and impacts (on plants, animals, materials) – Classifications, natural & artificial, primary & secondary, point &non point, linear & areal sources, stationary & mobile – Sampling and analysis of air pollutants – Ambient air quality standards by WHO (World Health Organisation) & CPCB (Centra Pollution Control Board).

UNIT - II : Air Pollution Meteorology

Properties of atmosphere: heat, pressure, wind forces, moisture and relative humidity – Lapse rates – Influence of terrain and meteorological phenomena on plume behaviour and air quality – Wind rose diagrams, plume rise models.

UNIT - III: Air Pollution Control and Monitoring

Control of particulates:control at sources, process changes, equipment modifications – Design and operation of control equipments, settling chambers, cyclone separators, fabric filters, scrubbers, electrostatic precipitators – Control of gases like SO_x, NO_x, CO and HC, Air-fuel ratio, computation and control of products of combustion – Monitoring of SPM, SO_2, NOx and CO, Stack Monitoring for flue gases.

UNIT - IV: Solid Waste Generation and Collection

Characteristics – types, sources, and properties of solid waste – Generation, typical generation rates, estimation of solid waste quantities, factors that affect generation of wastes – Collection services, types of collection systems, determination of vehicle and labour requirement and transportation of solid waste – Transfer stations, transfer means and methods.

UNIT - V: Solid Waste Management and Disposal

Engineered systems for solid waste management (refuse, reduce, reuse, recover, recycle) – Reuse of solid waste materials, processing techniques, materials recovery system, recovery of biological, thermal conversion products and recovery of energy from conversion products – Recycling of segregated waste materials – Ultimate Disposal of solid waste (Land filling, incineration, composting).

UNIT - VI: Noise Pollution and Control

Sources of noise pollution, impacts of noise, measurement of noise and permissible limits of noise, control methods of noise pollution, The Noise Pollution (Regulation and Control) Rules, 2000 as per CPCB.

Text Books

1. Air Pollution, M.N.Rao, H.V.N.Rao, 1st Edition, McGraw Hill Education.
2. Solid and Hazardous Waste Management, M.N.Rao, Razia Sultana, 1st Edition, BS Publications.
3. Noise Pollution and Its Control,H.C.Bhatia, 1st Edition, Atlantic Publisher.

Reference Books

1. Advanced Air and Noise Pollution Control, Lawrence K.Wang, Norman C. Pereira, Yung-Tss Hung, 2005 Edition, Humana Press.
2. Municipal Solid Waste Management, P.Jayarama Reddy, 1st Edition, B.S.Publications.

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Professional Elective - II

GROUND WATER DEVELOPMENT AND MANAGEMENT

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart knowledge on ground water flow in confined and unconfined aquifers.
- To familiarize with the principles involved in design and construction of wells.
- To provide awareness on improving the groundwater potential using various recharge techniques.
- To introduce the concept of saline water intrusion in coastal aquifers and its control measures.

Course Outcomes

Upon successful completion of the course, the students will be able to

- estimate aquifer parameters and yield of wells.
- analyse radial flow towards wells in confined and unconfined aquifers.
- design wells and understand the construction practices.
- select appropriate methods of artificial recharge for increasing groundwater potential.
- Illustrate effective measures for controlling saline water intrusion.

Course Content

UNIT - I: Introduction

Ground Water Occurrence: Ground water hydrologic cycle, origin of ground water, rock properties effecting ground water, vertical distribution of ground water, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention.

UNIT - II: Well Hydraulics

Steady radial flow and unsteady radial flow to a well in confined and unconfined aquifers, Theis solution, Jacob and Chow's methods, Leaky aquifers

UNIT - III: Well Design

Water well design-well diameter, well depth, well screen-screen length, slot size, screen diameter and screen selection, design of collector wells, infiltration gallery.

UNIT - IV: Well Development

Water wells, drilling methods-rotary drilling, percussion drilling, well construction-installation of well screens-pull-back method, open-hole, bail-down methods, well development-mechanical surging using compressed air, high velocity jetting of water, over pumping and back washing, well completion, well disinfection, well maintenance.

UNIT - V: Artificial Recharge

Artificial Recharge of Ground Water: Concept of artificial recharge – recharge methods, relative merits, Applications of GIS and Remote Sensing in Artificial Recharge of Ground water along with Case studies. Groundwater Basin Management: Concepts of conjunction use, Case studies.

UNIT - VI: Saline Water Intrusion

Saline Water Intrusion in aquifer: Occurrence of saline water intrusions, Ghyben-Herzberg relation, Shape of interface, control of seawater intrusion.

Text Books

1. Groundwater, H.M.Raghunath, third edition, New age international publishers
2. Ground water Hydrology by David Keith Todd, second edition, John Wiley & Son.

Reference Books

1. Groundwater, S.Ramakrishnan, second edition, Scitech publications
2. Ground Water Assessment: Development and Management, K. R. Karanth, twelfth reprint, Tata McGraw-Hill.

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Professional Elective - II

GROUND IMPROVEMENT TECHNIQUES

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart the need of ground improvement techniques in improving the strength parameters of soils.
- To familiarize with various dewatering methods
- To introducethe applications of reinforced earth, confinement systems and geo-synthetics

Learning Outcomes

Upon successful completion of the course, the students will be able to

- select suitable ground improvement techniques according to soil conditions.
- illustrate the concepts of reinforced earth systems.
- enumerate the concepts of soil confinement systems.
- explain the types and functions of geo-synthetics.

Course Content

UNIT - I: Introduction

Introduction – Need and objectives of Ground Improvement techniques, Classification of Ground Improvement techniques

Mechanical Stabilization – Methods of compaction, Shallow Compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic consolidation and Compaction piles

UNIT - II: Hydraulic Stabilization

Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells

Drains – Types, Preloading and Design features of Vertical Drains.

UNIT - III: Physical and Chemical Stabilization

Stabilization with admixtures like Cement, Lime, Calcium chloride, Fly ash and Bitumen

UNIT - IV: Reinforced Earth Techniques

Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Design of reinforcement for internal stability, Applications of Reinforced earth structures. Soil Nailing and Its applications

UNIT - V: Grouting and Soil Confinement Systems

Grouting – Objectives of grouting – grouts and their applications – methods of grouting

Soil Confinement Systems – Concept of confinement, Gabion walls, Crib walls, Sand bags

UNIT - VI: Geosynthetics

Geotextiles – types, functions, properties and applications; Geo-grids & Geo-membranes - properties and applications

Text Books

1. Ground Improvement Techniques,Purushotham Raj,2nd Edition, Laxmi Publications, New Delhi
2. An introduction to Soil Reinforcement and Geosynthetics, G.L.Siva Kumar Babu, 1st Edition, Universities Press.

Reference Books

1. Engineering Principles of Ground Modification,Hausmann M.R. (1990),1st Edition, McGraw-Hill International Edition.

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Open Elective - III

HYDROLOGY

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the knowledge of essential components of the hydrologic cycle
- To provide an overview and understanding of Unit Hydrograph theory and its analysis.
- To familiarize with different methods of flood frequency analysis and flood routing.
- To impart knowledge on groundwater movement and well hydraulics
- To familiarize with the relationships between soil, water and plant and their significance in planning an irrigation system

Learning Outcomes

Upon successful completion of the course, the students will be able to

- measure and analyze the rainfall in any given area and develop intensity-duration-frequency curves.
- quantify the abstractions from precipitation and the factors affecting
- determine runoff in a catchment and prepare the unit hydrograph which in-turn determines the runoff for any given rainfall
- estimate flood magnitude and carry out flood routing
- determine hydraulic properties of an aquifer and specific capacity, efficiency and yield of a well
- choose appropriate method of irrigation for different crops and cropping patterns and determine the quality and quantity of water required for a crop

Course Content

UNIT - I: Hydrologic Cycle

Introduction: Engineering hydrology and its applications, Hydrologic cycle. Precipitation: Types and forms of precipitation, rainfall measurement, types of rain gauges, rain gauge network, average rainfall over a basin, consistency of rainfall data, frequency of rainfall, intensity-duration-frequency curves, probable maximum precipitation.

UNIT - II: Abstractions

Abstractions: Evaporation, factors affecting evaporation, measurement of evaporation, evaporation reduction, evapotranspiration, factors affecting evapotranspiration, measurement of evapotranspiration - Infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.

UNIT - III: Runoff

Runoff :Factors affecting runoff ,components of runoff, computation of runoff-rational and SCS methods, separation of base flow ,Unit Hydrograph, assumptions, derivation of Unit Hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of UH

UNIT - IV: Floods

Floods-Causes and effects, flood frequency analysis-Gumbel's method, flood control methods, flood routing-hydrologic routing, hydraulic routing, channel and reservoir routing- Muskingum method of routing

UNIT - V Ground Water

Ground Water Occurrence: Ground water hydrologic cycle, origin of ground water, rock properties effecting ground water, vertical distribution of ground water, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention.

UNIT - VI: Irrigation

Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of Irrigation, methods of application of Irrigation water, water logging and drainage, standards of quality for Irrigation water, principal crops and crop seasons, crop rotation.

Text Books

1. Engineering Hydrology, P. Jayaram Reddy, third edition, Laxmi publications
2. Irrigation and water power engineering, B.C. Punmia, Pande B.B Lal, Ashok Kumar Jain & Arun Kumar Jain sixteenth edition, Laxmi publications.

Reference Books

1. Engineering Hydrology, K. Subramanya, third edition, Tata McGraw-Hill.. Hydrology principles, analysis and design, HM Raghunath, revised second edition, New Age International Publishers.
2. Irrigation Water Resources and Water Power Engineering, P.N.Modi, seventh edition, Standard Book House.

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Open Elective - III

PLANNING FOR SUSTAINABLE DEVELOPMENT

III Year – II Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objective

- To familiarize the concept of sustainable development
- To introduce various components of sustainable development

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the importance of sustainable development
- use various strategies for promoting sustainable development
- analyze important current issues and areas of debate in relation to sustainable development.
- implement policy responses in environmental degradation.

Course Content

UNIT - I: Introduction

Sustainable Development-explains and critically evaluates the concept of sustainable development, Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability,

UNIT - II: Key Components in Sustainable Development

Strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.

UNIT - III: Innovation for Sustainable Development

Innovation for sustainable development- Environmental management and innovation strategies.

UNIT - IV: Theories of Sustainable Development

Societal transformations.Institutional theory.

UNIT - V: Governance and Policy Response

Governance for sustainable development.Policy responses to environmental degradation.

UNIT - VI: Research in Sustainable Development

Capacity development for innovation.Research methods.

Text Books

1. Basic Principles for Sustainable Development,Harris, J.M, 2004.
2. Some thoughts on the idea of sustainable development Ecological Economics, Robinson, J. (2004), 48(4): 369-384.

Reference Books

1. Navigating towards Sustainable Development: A System Dynamics Approach, Hjorth, P. and A. Bagheri (2006), Futures 38: 74-92.
2. Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs ,Mog, J.M. (2004), World Development 32(12): 2139–2160. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure
3. Global Development and Environment Institute, working paper 00-04. Available at:http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF.

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Open Elective - III

ELECTRICAL AND HYBRID VEHICLES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts on working principles of electric drives used for different hybrid electric vehicles.
- To familiarize with the different energy storage systems and their management strategies.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe hybrid vehicles and their performance
- analyze various power converter configurations of hybrid electric drives.
- analyze and suggest possible energy storage systems for different applications.
- apply the appropriate energy management strategies for various applications.

Course Content

UNIT - I: Introduction to Hybrid Electric Vehicles

History of hybrid and electric vehicles, electric vehicles, impact of modern drive-trains on energy supplies.

UNIT - II: Hybrid Electric Drive-trains

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies

UNIT - III: Electric Drive-trains

Basic concept of electric traction Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC and AC Motor drives

UNIT - IV: Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis.

UNIT - V: Hybridization of different energy storage devices

Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine, sizing the power electronics, selecting the energy storage technology.

UNIT - VI: Energy Management Strategies

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015

Reference Books

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

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Open Elective - III

POWER PLANT INSTRUMENTATION

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide an overview of different methods of power generation with a particular stress on thermal power generation.
- To impart knowledge on the different types of controls loops.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe the constructional details, working principles of various generating stations.
- analyze the working of different types of controls and control loops.
- choose various measurements involved in power generation plants.
- understand the knowledge about the different types of devices used for analysis.

Course Content

UNIT - I: Overview Of Power Generation

Brief survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler processes UP&I diagram of boiler – cogeneration.

UNIT - II: Measurements In Power Plants

Electrical measurements – current, voltage, power, frequency, power – factor etc. – non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.

UNIT - III: Analyzers In Power Plants

Flue gas oxygen analyser – analysis of impurities in feed water and steam – dissolved oxygen analyser – chromatography – PH meter – fuel analyser – pollution monitoring instruments.

UNIT - IV: Control Loops In Boiler

Combustion control – air/fuel ratio control – furnace draft control – drum level control – main stem and reheat steam temperature control – super heater control – attemperator –deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT - V: Turbine – Monitoring And Control

Speed, vibration, shell temperature monitoring and control – steam pressure control – lubricant oil temperature control – cooling system

UNIT - VI: Analysis in Power Plant

Thermal conductive type, paramagnetic type-Oxygen analyzer, hydrogen purity meter-chromatography – PH meter,fuel analyzer, pollution monitoring and control

Text Books

1. Sam G. Dukelow, 'The control of Boilers', Instrument Society of America,1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.
3. E.L Wakil, M.M./Power Plant technology/Mc Graw Hill 1984.
4. J.Balasubramaniam & R.K Jain/Modern Power Plant Engineering/Khanna

Reference Books

1. Elonka,S.M.and Kohal A.L.Standard Boiler Operations, McGraw-Hill, New Delhi,1994.
2. R.K.Jain, Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 1995.

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Open Elective - III

MATERIAL SCIENCE

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- to understand the properties of engineering materials, so as to manipulate them for the desired engineering applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- compare the different types of conductors and semi conductors and their applications
- classify magnetic materials based on their parameters
- understand the applications of dielectric principles in engineering devices.
- propose a corrosion prevention technique for a particular application
- summarize the different optical properties of metallic materials
- apply different characterization techniques for validation of metals.

Course Content

UNIT - I: Conductors, Semi Conductors and Resisters

Resistivity, Range of Resistivity- free electron theory - classical theory & quantam theory. Semiconducting materials: Energy gap in solids - intrinsic semi conductors - extrinsic semi conductors - element & compund semi conductors - crystal structure - growth & purification of semi conductor crystals.

UNIT - II: Magnetic Materials

Magnetic Materials: Classification of magnetic materials based on spin - Hard and soft magnetic materials - Dia, Para & Ferro types, atomic magnetic moment - anti ferro magnetism.

UNIT - III: DIELECTRIC MATERIALS

Dielectric Materials: Dielectric susceptability - complex die electric constant - Polarization mechanisms in dielectrics - Frequency and temperature dependence of polarization mechanism - Dielectric loss - Dielectric waveguide and dielectric resonator antenna - Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT - IV: Optical Properties of Materials

Introduction - electromagnetic radiation - light interactions with solids - Refraction, Reflction, Absorption, Transmission, Opacity & Translucency in insulators - Luminescence - Photo conductivity.

UNIT - V: Corrosion & Oxidation

Corrosion: Principles of corrosion - electrode potential - galvanic series - galvanic cell - polarization - passivation - electro chemical considerations - corrosion rate - forms of corrosion - corrosion prevention.

Oxidation: Mechanisms of oxidation - oxidation resistant materials.

UNIT - VI: Materials Characterization

X-ray diffraction, Neutron diffraction and Electron diffraction - X-ray fluorescence spectroscopy - Thermogravimetric Analysis (TGA) - Differential Thermal Analysis (DTA) - Differential Scanning Calorimetry (DSC).

Text Books

1. V. Raghavan, "Materials Science and Engineering", PHI Learning Publication, 5th edition.
2. Rajendran, V. "Materials Science",Tata McGraw- Hill,New Delhi,2011.

Reference Books

1. William D. Callister, "Materials Science and Engineering" 9th ed., John Wiley and sons, Incorporated.
2. Sam Zhang, "Materials Characterization Techniques", CRC Press.
3. J. M. D. Coey, "Magnetism and Magnetic Materials", Cambridge University Press.

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Open Elective - III

RENEWABLE ENERGY SOURCES

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To study various types of non-conventional sources of energy and techniques used in exploiting solar, wind, tidal and geothermal sources of energy and bio-fuels.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the significance of renewable energy.
- describe the principles of solar radiation and design the solar collectors.
- know the functioning of basic components of wind energy and understand the utilization of biomass in power generation.
- discuss the working principles of geothermal, ocean, tidal and wave energy techniques.
- know the functioning of direct energy conversion techniques.

Course Content

UNIT - I: Introduction

Energy Sources and their availability, Role and potential of renewable source.

Principles of Solar Radiation: Solar constant, Solar Radiation outside the Earth's atmosphere, Solar Radiation at the Earth's surface, instruments for measuring solar radiation, solar radiation geometry, solar radiation on titled surfaces with numerical problems.

UNIT - II: Solar Energy Storage and Applications

Different methods, sensible, latent heat and stratified storage, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation, drying, photovoltaic energy conversion, solar central power tower concept and solar chimney. solar collectors- flat plate, concentric collectors.

UNIT - III: Wind Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

Bio-Mass: Biomass Energy Sources, methods for obtaining energy from biomass, Biomass gasification.

UNIT - IV:

Geothermal Energy: Resources, types of wells, methods of harnessing the energy.

Ocean Energy: OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles.

Tidal and wave energy: Potential and conversion techniques, Mini-hydel power plants

UNIT - V:

Direct Energy Conversion (DEC): Need for DEC, limitations, principles of DEC. Thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators.

UNIT - VI: MHD Power Generation

Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion.

Fuel cells: Principles, Faraday's laws, thermodynamic aspects, selection of fuels and operating conditions, applications.

Text Books

1. Tiwari and Ghosal, "Renewable energy resources", Narosa.
2. B.H.Khan "Non – conventional Energy Resources" Tata McGraw Hill education Pvt Ltd.

Reference Books

1. G.D. Rai, "Non-Conventional Energy Sources", Dhanpat Rai and Sons
2. Twidell & Weir, "Renewable Energy Sources " Sukhatme, "Solar Energy", Tata McGraw-Hill Education.

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Open Elective - III

ASSISTIVE TECHNOLOGIES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce different assistive technology devices
- To familiarize with the concepts of enhance speech communication and independent living.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the legislative policies connected with assistive Technologies
- know the universal design principles in the context of general education environments and curriculum materials.
- explore the process for finding the right technology and the right applications and determine how to pay for it.

Course Content

UNIT - I: Introduction to Assistive Technology (AT) Devices and Services

Assistive technology defined, historical overview of assistive technology, multidisciplinary nature of service provision.

UNIT - II: Adaptations Framework for Considering Assistive Technology

Introduction to the adaptations framework, setting-specific demands, person-specific characteristics, adaptations, evaluation of effectiveness of adaptations.

UNIT - III: Assistive Technology Assessments

Overview of assessment issues, overview of general assessments, assistive technology assessments, assessment components.

UNIT - IV: Enhance Speech Communication

Nature of spoken language, introduction to augmentative and alternative communication systems, selection techniques for aided communication systems, overview of non-electronic systems and electronic devices.

UNIT - V: Mobility and Access to Information

Introduction to mobility adaptations, basic design considerations, seating and positioning issues, introduction to information access, computer access, telecommunication, listening and print access.

UNIT - VI: Enhance Independent Living

Introduction to independent living, devices for daily life, switches and scanning, environmental control units, access to management devices.

Text Books:

1. Diane P edrotty Bryant, Brian R. Bryant, Allyn and Bacon "Assistive Technology for People with Disabilities", 2nd edition, Psycho Educational Services.
2. Amy G.Dell, Deborah A. Newton, Jerry G.Petroff, "Assistive Technology in the class room Enhancing the school experiences of students with disabilities", Pearson Publications, 2nd edition.

Reference Books

1. Marion A.Hersh, Michael A.Johnson, "Assistive Technology for the Hearing impaired, Deaf and Deafblind", Springer Publications, 2003.
2. Meeko Mitsuko K.Oishi, Ian M.Mitchell, H.F. Machiel vanderloss, "Design and use of Assistive Technology", Springer Publications, 2010.
3. Eckehard Fozzy Moritz, "Assistive Technologies for the Interaction of the Elderly", Springer Publications, 2014.

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Open Elective - III

BIO-MEDICAL ENGINEERING

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basics of biological concepts and relate it to engineering.
- To familiarize with physiology of cardio-vascular system, respiratory system & the elements of Patient Care Monitoring.
- To impart the knowledge on the patient monitoring displays, diagnosis & techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- know the concept of bio-medical engineering, evolution, age, development, advancements and applications.
- get awareness on noval theory related to human body and various components.
- analyze the operation of measuring the cardio-vascular system by knowing its inner organization, sensor and transducer theory & plethysmographical concepts.
- learn the principles of respiration and respiratory therapy equipment.
- understand the fundamental principles & techniques of diagnosys and bio-telemetry, monitors, recorders.

Course Content

UNIT - I: Introduction to Bio-Medical Instrumentation

Man instrumentation system-introduction & components, physiological system of the body, sources of bio-electric potentials, resting & action potentials,Electro-Cardiogram(ECG),Electro-Encephalogram(EEG), Electro Myogram (EMG),envoked responses.

UNIT - II: Electrodes & Transducers

Bio-potential electrodes, basic transducers-transduction principles, biochemical transducers, active & passive transducers, transducers of bio-medical applications, pulse sensors, respiration sensors.

UNIT - III: Cardio-Vascular System & Respiratory System Measurements

The heart & cardiovascular system, Electro-Cardiography, blood pressure measurement, measurement of blood flow & cardiac output, the physiology of the respiratory system, tests & instrumentation for the mechanics of breathing, respiratory therapy equipment.

UNIT - IV: Patient Care & Monitoring

Elements of intensive care monitoring, patient monitoring displays, diagnosis, calibration & repair ability of patient monitoring equipment, organization of the hospital for patient care monitoring, pace-makers, defibrillators.

UNIT - V: Diagnostic Techniques & Bio-Telemetry

Principles of ultrasonic measurement, Ultrasonic Imaging, Ultrasonic Diagnosis X-Ray & Radio-Isotope Instrumentations CAT Scan, Emission Computerized Tomography, MRI, Introduction & components of bio-telemetry system.

UNIT - VI: Monitors, Recorders & Shocking Hazards

Monitors, recorders, shock hazards & prevention, physiological effects & electrical equipment, methods of accident prevention, isolated power distribution system.

Text Books

1. Onkar N. Pandey, Rakesh kumar, "Bio-Medical Electronics and Instrumentation", S. K. Kataria & Sons, 2007.
2. Cromewell, Wiebell, P.feiffer, "Biomedical instrumentation and measurements", Prentice-Hall, 1973.

Reference Books

1. Joseph J.Carr, John M.Brown, "Introduction to Bio-Medical Equipment Technology", Pearson Publications, 4th Edition.
2. Khandapur, "Handbook of Bio-Medical Instrumentation", TMH, 2nd Edition.

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Open Elective - III

NODE AND ANGULAR JS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with defining own custom AngularJS directives that extend the HTML language
- To introduce the concepts of client-side services that can interact with the Node.js web server
- To understand the best practices for server -side JavaScript

Learning Outcomes

Upon successful completion of the course, the students will be able to

- develop single page applications that reduces app's time to market without plugins.
- identify the services, modules and directives to subdivide application logic into modules and share code across apps
- explain the routing process in angular for managing URL's.
- interpret command line applications in Node.js that allows developers a more maintainable code
- develop code with use of Node.js and JSON services for web applications.
- examine how error events affect piped streams and handling events in Node.js

UNIT - I: Introduction to Node.js and JSON

Introduction, operators, decision and iterative statements, Node.js collections: create array object, insert, access, update and remove data. JSON:Create JSON object, display, access and edit data. JSON Array: Creation, display, access and edit data. Check JSON attribute.

UNIT - II: Node.js Files, Functions and Strings

File modules, reading text, creating file. Functions: creating function, types of functions, callback function. Strings: operations, string to numeric and vice-versa, string parser.

UNIT - III: Node.js Modules, Error Handling & Logging and Events

Create simple module, module class. Error handling and logging. Events: Events module, once event listener, remove events.

UNIT - IV: Introduction to Angular

Introduction to TypeScript (TS), node package manager, introduction to Angular 4, create angular application using TS and angular CLI, webpack, gulp introduction.

UNIT - V: Elements in Angular

Angular components, controllers, modules, dependency injection, angular service, providers and directives, pipes and filters, Angular forms-Reactive, lifecycle hooks.

UNIT - VI: Routing in Angular

Routing-module, component, lazy loading of components, apply route guards-security, Angular material design.

Text Books

1. Andrew Grant, "Beginning AngularJS", Apress Publishers.
2. Agus Kurniawan, "Nodejs Programming By Example", PE Press.

Reference Books

1. Ken Williamson,"Learning AngularJS: A Guide to AngularJS Development", O'Relly Media.
2. Matt Frisbie, "AngularJS Web Application Development Cookbook", Packt Publishing Ltd.
3. David Herron, "Node.js Web Development", 4th edition, Packt Publishing Ltd.
4. Marc Wandschneider, "Learning Node.js: A Hands-On Guide to Building Web Applications in JavaScript", Addison Wesley.

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Open Elective - III

CYBER SECURITY

III Year – II Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To understand security concepts, Ethics in Network Security.
- To familiarize with new algorithms (mathematical formulas) and statistical measures that assesses relationships among members of large data sets.
- To identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks, and apply those to design and evaluate counter measure tools.
- To gain knowledge on security threats, and the security services and mechanisms to counter them.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline management framework.
- describe various tools that can be used in cyber security management.
- write a secure access client for access to a server.
- determine firewall requirements, and configure a firewall.
- employ policies and standards to solve security problems.
- use security techniques in an organisational context.

UNIT - I: Systems Vulnerability Scanning

Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks vulnerability scanning - Netcat, understanding port and Services tools-Datapipe, Fpipe, Network reconnaissance –Nmap, THC-Amap. Network sniffers and injection tools–Tcpdump and Windump.

UNIT - II: Network Defence Tools

Firewalls and packet filters: Firewall basics, packet filter vs firewall, how a firewall protects a network, packet characteristic to filter, stateless vs stateful firewalls, network address translation (NAT) and port forwarding, the basic of virtual private networks, Snort: Intrusion detection system.

UNIT - III: Web Application Tools

Scanning for web vulnerabilities tools: Nikto, HTTP utilities-Curl, OpenSSL and stunnel, password cracking and Brute-Force tools–John the Ripper,L0phtCrack, pwdump, HTC-Hydra.

UNIT - IV: Introduction to Cyber Crime and Law

Cyber crimes, types of cyber crime, hacking, attack vectors, cyberspace and criminal behavior, clarification of terms, traditional problems associated with computer crime.

UNIT - V: Introduction to Incident Response

Digital forensics, computer language, network language, realms of the cyber world, a brief history of the Internet, recognizing and defining computer crime, contemporary crimes, computers as targets, contaminants and destruction of data, Indian IT ACT 2000.

UNIT - VI: Introduction to Cyber Crime Investigation

Firewalls and packet filters, password cracking, keyloggers and spyware, virus and worms, Trojan and backdoors, steganography, attack on wireless networks.

Text Books

1. Mike Shema, "Anti-Hacker Tool Kit (Indian Edition)", Publication Mc Graw Hill.
2. Computer forensics and cyber crime : an introduction by Marjie T. Britz.

Reference Books

1. James Graham, Ryan Olson, Rick Howard, "Cyber Security essentials", 1st edition.
2. Chwan-Hwa (John) Wu, J. David Irwin, "Introduction to Computer Networks and Cybersecurity".
3. Nina Godbole and Sunit Belpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Publication Wiley.

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Open Elective - III

SCRIPTING LANGUAGES

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with JQuery, JSON, PERL, Ruby, AJAX to develop client-side and server-side web applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- use jQuery with DOM to manipulate HTML elements, attributes and CSS.
- store and exchange data between server and browser using JSON.
- develop PERL scripts using arrays, hashes, control structures and subroutines.
- write Ruby scripts usingdata types, arrays, hashes, control structures and classes.
- retrieve data from a database using PHP and AJAX.

Course Content

UNIT - I : jQuery

Introduction, Selectors, Events, Effects, Manipulating HTML and CSS using jQuery

UNIT - II: JSON

Introduction, Syntax rules, JSON Vs XML, Data types, Objects, Arrays, Parsing JSON and using stringify() function

UNIT - II: Introduction to PERL

Basic syntax, Perl language elements: variables, operators, control flow statements, Arrays, Hashes and File handling; Regular expressions, Subroutines

UNIT - IV: Working with PERL

Packages and modules, Working with files, Retrieving documents from the web with Perl.

UNIT - V: Ruby

Introduction to Ruby, Variables, types, simple I/O, Control, Arrays, Hashes, Methods, classes, Iterators, Pattern Matching. Overview of Rails.

UNIT - VI: AJAX A New Approach

Introduction, Creating XMLHttpRequest object, Integrating AJAX with PHP, Retrieving data from a database using PHP and AJAX, Handling XML data using PHP and AJAX.

Textbooks

- Kogent , HTML 5 Black Book, 2nd Edition, Dreamtech Press
- Dave Thomas, Programming Ruby 1.9 & 2.0: The Pragmatic Programmers' Guide, 4th Edition, Pragmatic Bookshelf
- Randal L. Schwartz,ý Brian D. Foy ,ý Tom Phoenix, Learning Perl, 6th edition,O'REILLY Publications.

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Open Elective - III

SOFTWARE PROJECT MANAGEMENT

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce plan and manage projects at each stage of the software development life cycle (SDLC).
- To impart effective software projects that support organization's strategic goals.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the different software projects.
- prepare project plans that address real time management challenges.
- relate important risks facing a new project.
- design effective software development model to meet organizational needs.
- recognize appropriate methodology to develop a project schedule.
- apply appropriate techniques to assess ongoing project performance.

Course Content

UNIT - I: Conventional Software Management

The waterfall model, conventional software Management performance.

Evolution of Software Economics: Software Economics, pragmatic software cost estimation.

Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness.

UNIT - II: Principles of Modern Software Management

The old way and the new: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.

UNIT - III: Checkpoints and Process Planning

Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments.

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating.

UNIT - IV: Project Organizations

Project Organizations And Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.

Process Automation: Automation Building blocks.

UNIT - V: Project Control and Process Instrumentation

The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation, **Tailoring the Process**- Process discriminants.

UNIT - VI: Future Software Project Management

Modern Project Profiles, Next generation Software economics, modern process transitions.

Text Books

1. Walker Royce,Software Project Management, Pearson Education, 2005.

Reference Books

1. Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw-Hill Edition.
2. Joel Henry, Software Project Management, Pearson Education.
3. PankajJalote, Software Project Management in practice, Pearson Education, 2005.

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Open Elective - III

ELEMENTS OF STOCHASTIC PROCESSES

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Outcomes

- To study and understand the systems which evolve randomly over time, especially in long run.
- To survey the important tools of stochastic processes.
- To model and solve engineering problems arising in real life situations.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- formulate and solve probabilistic problems using random variables.
- distinguish between Poisson process and the exponential random variable and apply this knowledge to solve problems involving memory less processes.
- use renewal theory to solve problems where Poisson is not a realistic processes.
- ise Markov chain is discrete and continuous time to solve queuing problems.

Course Content

UNIT - I: Generating Functions

Introduction, Definitions and elementary results, Convolutions, Compound distributions, Partial fraction expansions, Moment and cumulant generating functions.

UNIT - II: Recurrent Events

Definitions, Basic theorems, Delayed recurrent events.

Random Walk Models: Introduction, Gambler's Ruin, Probability distribution of ruin at nth trial and extensions.

UNIT - III: Markov Chains

Introduction, Notation and definition, classification of states, classification of chains, Evaluation of P^n (transition probability matrix)

UNIT - IV: Markov Process

Discrete and continuous – The Poisson process, Use of generating functions, Random variable technique, Solution of linear partial deferential equations.

UNIT - V: Homogeneous and Non-Homogeneous Birth and Death Processes

Introduction, simple birth process, general birth process, divergent birth processes. Simple death process, simple birth and death processes, the effect of immigration, the general birth and death process, multiplication processes. Polya process, a simple non-homogeneous birth and death process. The effect of immigration.

UNIT – VI: Queuing process

Introduction, Equilibrium theory, Queues with many servers, Monte carlo methods in appointment systems, Non-equilibrium treatment of a sample queue, First passage times, Diffusion process.

Text Book

1. The Elements of Stochastic Processes, Norman T.J. Bailey.

Reference Book

1. Stochastic Processes, J. Mehdi

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Open Elective - III

ACADEMIC COMMUNICATION

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To acquaint the students with the process and elements of academic writing.
- To help them gain accuracy in the academic writing tasks they will be called upon to perform as part of their graduate and postgraduate studies.
- To empower them to carry out academic writing tasks such as project report writing with success.

Learning Outcomes

Upon successful completion of the course, the student will be able to produce successful academic writing tasks (such as designing and reporting a survey/project, writing discussion essays, and composing formal letters) with attention to:

- the writing process involving a good understanding of the purpose and the register as well as organizational strategies such as introduction, main body, conclusion, paragraphing;
- the elements of academic writing such as argument, cause and effect, cohesion and coherence, generalizations, references, style, and visual information; and
- the kind of accuracy, technical as well as grammatical, that writing in academic contexts demands

Course Content

I. The Writing Process

a. Background to writing

i. The purpose of academic writing

ii. Common types of academic writing

iii. The features of academic writing

iv. Writing in paragraphs

b. From understanding to planning

i. The planning process

ii. Analyzing essay titles

iii. Brainstorming

- **c. Organizing paragraphs**
  - i. Paragraph structure
  - ii. Development of ideas
  - iii. Linking paragraphs together
- **d. Introductions and conclusions**
  - i. Introduction contents
  - ii. Introduction structure
  - iii. Opening sentences
  - iv. Conclusions
- **e. Re-writing and proof-reading**
  - i. Re-writing
  - ii. Proof-reading

II. Elements of Writing

- **a. Cohesion**
  - i. Reference words
  - ii. Preventing confusion
- **b. Comparisons**
  - i. Comparison structures
  - ii. Forms of comparison
  - iii. Using superlatives
- **c. Style**
  - i. Components of academic style
  - ii. Guidelines
- **d. Visual information**
  - i. The language of change
  - ii. Types of visuals
  - iii. Describing visuals
  - iv. Labelling

III. Accuracy in Writing

- a. Academic vocabulary
- b. Remedial grammar
- c. Punctuation

IV. Writing Models

- a. Formal/Professional emails
- b. CVs
- c. Reports
- d. Scholarly essays

Suggesting Reading

1. Bailey, Stephen. (2011). *Academic Writing A Handbook for International Students*. Routledge: London.

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Optional Elective - V

SMART BUILDING AND AUTOMATION

III Year – II Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concept of building management systems.
- To emphasize the importance of automating the building operations for safety, health and economy.
- To demonstrate current trends in home automation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the concepts of DAQ, M2M, SCADA, BMS and IoT.
- list out the categories of hardware needed for automating the operation of building systems.
- identify the issues of communication standards for integrating systems.
- detail the aspects of human comfort that can be managed automatically.
- emphasize the importance of security and safety and its automation.
- illustrate current developments in the field of home automation.

Course Content

UNIT - I: Building Management Systems

Introduction: data acquisition from devices (DAQ), machine to (2) machine communication (M2M) between devices, Supervisory Control and Data Acquisition (SCADA), Building Management Systems (BMS), Internet of Things (IoT) Structure, components, commissioning – Differences between SCADA, BMS and IoT, dashboards and user interfaces.

UNIT - II : Hardware needed for control

Sensors, actuators, variable speed drives, cameras, network cabling, UPS (uninterrupted power supply), scanners, PLC (Programmable Logic Controller), ethernet, installation, integration, commissioning, retro-commissioning.

UNIT - III: Software needed for DAQ and bus standards.

Proprietary and open standards; MODBUS, Lonworks, Bacnet, KNX, Data Protocols, Data security, legacy systems integration

UNIT - IV: Controlling Occupant Comfort

Lighting, Ventilation, Cooling and Heating, Smoking Areas, Enhanced Ventilation for special areas – Automated control of comfort using BMS.

UNIT - V: Security and Access Control

Fire Safety and Smoke Detection, CCTV, intrusion alarms, parking ventilation, lifts, emergency systems, plumbing – Automated tracking of security and safety using BMS.

UNIT - VI: Smart Homes

Smart Speakers from Amazon (Echo), Google (Home), Microsoft (Invoke by Harman Kardon), Apple (Home Pod) – integration with alarms &sensors – heating &cooling– lights &switches – video Camera.

Text Books

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Hanes David, Salgueiro Gonzalo, Grossetete Patrick, Barton Rob, Henry Jerome, Pearson Education, Cisco Press, Paperback – 16 Aug 2017.
2. Automation Systems In Smart and Green Buildings,V.K. Jain, Khanna Publishers, 2009.

Reference Books

1. Building Automation: Communication systems with EIB/KNX, LON and BACnet, Hermann Merz, Thomas Hansemann, Christof Hübner, Springer 2nd Edition. 2018.
2. Internet of Things (Smart Sensors, Measurement and Instrumentation), Subhas Chandra Mukhopadhyay, Springer, 2014.

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Optional Elective - V

BUILDING INFORMATION MODELING

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introducethe importance of Building Information Modelling (BIM) in Architecture, Engineering and Construction (AEC) industry
- To familiarise the use of BIM with owners, facility managers, architects, engineers and contractors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the knowledge of inefficiencies with 2D and advantages of 3D modeling
- make use of BIM tools for model designing.
- adopt BIM towards risk identification.
- appraise the advantages and applications of BIM for designers and engineers
- provide the scope and guidance of BIM for contractors and suppliers.
- acknowledge wide use of BIM enabled processes for fabrications.

Course Content

UNIT - I: Introduction

The current (Architecture, Engineering and Construction) AEC business model, Documented inefficiencies of traditional approaches, BIM: New Tools and New Processes.

UNIT - II: BIM Tools & Parametric Modeling

The Evolution of object –based parametric modelling, BIM Environments, platforms and tools, Major BIM Design platforms,

Interoperability- different kinds of exchange formats, the evolution from file-Based exchange to building.

UNIT - III: BIM for Owners and Facility Managers

BIM application areas for owners, tool guide for owners, Owner and Facility Manager's.

Building model, Barriers to Implementing BIM: Risks and Common Myths, Guidelines and Issues for Owners to Consider when Adopting BIM.

UNIT - IV: BIM for Architects and Engineers

Scope of design services, use in design processes, building object models and libraries, considerations in adoption for design practices.

UNIT - V: BIM for Contractors

Types of Construction Firms, Information Contractors Want from BIM, Processes to Develop a Contractor Building Information Model, Reduction of Design Errors Using Clash Detection, Quantity Takeoff and Cost Estimating, Construction Analysis and Planning, Integration with Cost and Schedule Control and Other Management Functions, Use of BIM Onsite: Verification, Guidance and Tracking of Construction Activities.

UNIT - VI: BIM for Subcontractors and Fabricators

Types of Subcontractors and Fabricators, BIM-Enabled Process Change, Generic BIM System Requirements for Fabricators, Major Classes of Fabricators and Their Specific Needs, Adopting BIM in a Fabrication Operation.

Text Books

1. BIM Handbook- A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors, Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, 4nd Edition, John Wiley & sons publications.
2. BIM and Construction Management: Proven Tools, Methods, and Workflows, Brad Hardin & Dave McCool, John Wiley & sons publications.

Reference Books

1. BIM for Construction Clients, Richard Saxon, 1st Edition, RIBA Publishing.
2. BIM Design: Realising the Creative Potential of Building Information Modeling, Richard Garber, John Wiley &sons publications.

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Optional Elective - V

DATABASE MANAGEMENT SYSTEMS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize the concepts of database systems and different issues involved in the database design.
- To introduce how to write SQL for storage, retrieval and manipulation of data in a relational database.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- recognize the importance of database system over file processing system.
- analyze an information storage problem and derive an information model in the form of an entity relationship diagram.
- write simple and complex queries using Structured Query Language (SQL) for storage, retrieval and manipulation of data in a relational database.
- employ principles of normalisation for designing a good relational database schema.
- describe the issues and techniques relating to concurrency and database recovery in a multi-user database environment.

Course Content

UNIT - I: Introduction to Database

Introduction, advantages of using DBMS, data models, levels of abstraction, entity-relationship model: attributes and keys, relationship types, weak entity set, strong entity set, specialization and generalization, database design for banking enterprise, reduction to relational schemas.

UNIT - II: Relational Model and SQL

Relational Model: Basic concepts, schema and instances, keys, relational algebra, SQL: DDL, DML, integrity constraints, defining different constraints on a table, set operations, aggregate functions, group by and having clauses, nested queries.

UNIT - III: Database Design

Functional dependencies: Partial, full, transitive and trivial dependencies, Axioms, Decomposition: Lossless Join and dependency preserving decomposition, attribute closure, Normal forms: 1NF, 2NF, 3NF and BCNF.

UNIT - IV: Transaction Management

Transaction concept, ACID properties, transaction state diagram, schedules-serial, concurrent and serializable schedules, serializability- conflict and view serializability, recoverability.

UNIT - V: Concurrency Control

Concurrency Control- Concurrent execution of transactions, anomalies due to concurrent execution, lock-based protocols-2PL, Strict 2PL and Rigorous 2PL, timestamp-based protocols, Thomas write rule, deadlock handling-deadlock prevention, deadlock detection and recovery.

UNIT - VI: Crash Recovery

Crash Recovery - Failure classification, different types of recovery techniques: deferred update, immediate update, shadow paging, checkpoints.

Text Books

1. Korth and Sudarshan, "Database system concepts", 3rd edition, MH.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd edition, MH

Reference Books

1. Elmasri Navate, "Fundamentals of Database Systems", 5th edition, Pearson Education
2. C.J.Date, "Introduction to Database Systems", 8th edition, Pearson Education
3. Peter Rob and C Coronel, "Database Systems Design, Implementation, and Management", 7th edition.

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Professional Elective - III

PRE-STRESSED CONCRETE

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concept of prestressing and IS code provisions.
- To impart the knowledge on analysis and losses of prestress
- To introduce design procedures of pre-stressed concrete members under flexure and shear

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply concepts & methods for pre stressing systems
- analyze pre-stressed concrete members for flexure
- design pre-stressed concrete beamsconsidering the different losses
- evaluate shearresistance of pre-stressed concrete members
- determine the deflections of pre-stressed concrete members
- analyze and design the end blocks.

Course Content

UNIT - I: Introduction to Prestressed Concrete

Historic development – General principles of pre-stressing, pre-tensioning and post tensioning – Advantages and limitations of pre-stressed concrete – Materials – High strength concrete and high tensile steel their characteristics, Durability, Cover requirements for PSC members.I.S. Code provisions, Methods and Systems of Pre-stressing; Pre-tensioning and post tensioning methods – Different systems of pre-stressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System.

UNIT - II: Analysis of Prestressed Members

Analysis of sections for flexure: Elastic analysis of concrete beams pre-stressed with straight, concentric, eccentric, bent and parabolic tendons. Pressure Line or Thrust Line, concept of load balancing.

UNIT - III: Losses of Prestress

Losses of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage bending of member and frictional losses, total Losses allowed for design

UNIT - IV: Design of Section for Flexure and Shear

Design of Section for Flexure and Shear: Allowable stress, Design criteria as per I.S. Code – Elastic design of simple rectangular and I-section for flexure, shear, and principal stresses – design for shear in beams – Kern – lines, cable profile.

UNIT - V: Deflections of Prestressed Concrete Beams

Importance of control of deflections –factors influencing deflections–short term deflections of un-cracked member's prediction of long term deflections, Deflection of Cracked members.

UNIT - VI: End Blocks

Analysis of End Blocks by Guyon's method and Magnel method, Anchorage zone stresses - Approximate method of design –Anchorage zone reinforcement - Transfer of pre-stress pre-tensioned members.

Text Books

1. Prestressed Concrete by N Krishna Raju, 5thedition, Tata McGraw Hill Publications.
2. Prestressed Concrete by Ramamrutham, 5thedition, Dhanpatrai Publications.

Reference Books

1. Fundamentals of Pre-stressed Concrete by Sinha N.C. and Roy S.K, 3rdedition, S.Chand & Company limited.
2. Pre-stressed concrete structures by N.Rajagopalan, 2nd edition, Alpha Science International Ltd
3. Design of Pre-stressed concrete structures by T.Y. Lin & Ned H.Burns, 3rdedition, John Wiley & Sons
4. IS 1343- 2012 Indian standard code of practice for Pre-stressed concrete.

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Professional Elective - III

ADVANCED FOUNDATION ENGINEERING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with advanced knowledge of foundations in various practices
- To appreciate the foundation practices in difficult soil conditions under different loading conditions

Learning Outcomes

Upon successful completion of the course, the students will be able to

- compute the bearing capacity of foundations at abnormal conditions
- calculate oil settlements for cohesive and cohesion less soils using advanced methods
- explain swelling characteristics of soil
- check various stability conditions for retaining structures

Course Content

UNIT - I: Mat Foundation

Mats/ Rafts – Proportioning of footings – Ultimate bearing capacity of mat foundations – allowable bearing capacity of mats founded in clays and granular soils

UNIT - II: Settlement Analysis

Immediate settlement of footings resting on granular soils – Schmertmann& Hartman method – De Beer and Martens method - Immediate settlement in clays – Janbu's method – Correction for Consolidation settlement using Skempton and Bjerrum's method – Correction for construction period

UNIT - III: Earth Retaining Structures

Cantilever sheet piles – anchored bulkheads – fixed and free earth support methods – design of anchors – braced excavations – function of different components – forces in ties – stability against bottom heave.

UNIT - IV: Laterally Loaded Piles

Negative skin friction (NSF) -settlement of pile groups in sands and clays – laterally loaded piles in granular soils – Reese and Matlock Method – laterally loaded piles in cohesive soils – Davisson and Gill method – Broms' analysis.

UNIT - V: Swelling Characteristics

Swelling - factors affecting swelling; Swelling potential - swell pressure - Methods of determination – factors affecting swelling potential and swell pressure; Heave – factors affecting heave- methods of determination of heave

UNIT - VI: Foundation Practices in Expansive Soils

Sand cushion – Belled Piers – Granular pile, Under – reamed pile foundations – Construction techniques – design specifications – Load - carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands

Text Books

1. Basic and applied soil mechanics, Gopal Ranjan and AS Rao, 2nd Edition, New Age Publishers.
2. Principles of Foundation Engineering, BM Das, 7th Edition, Cengage Learning

Reference Books

1. Foundation Analysis and Design, JE Bowles, 5th Edition, Mc Graw Hill Publications
2. Soil Mechanics and Foundation Engineering, VNS Murthy, 1st Edition, CBS Publishers
3. Foundation Design, WC Teng, 13th Edition, Prentice Hall Publishers.

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Professional Elective - III

TRAFFIC ENGINEERING

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce fundamental knowledge of traffic engineering.
- To acquire design principles of traffic engineering.
- To familiarize with various traffic issues including planning, safety, operation and control.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- develop a basic knowledge on the fundamental issues in traffic engineering.
- demonstrate the clear understanding of the factors influencing road vehicle performance.
- define the basic principles in highway geometric design and apply these principles to solve simple problems.
- apply the principles of traffic flow and queuing theory in designing signaling systems.
- explain the critical procedures for highway capacity and level of service analysis.

Course Content

UNIT - I: Traffic Characteristics

Basic traffic characteristics - Speed, volume and concentration, Relationship between Flow, Speed and Concentration Volume Studies- Objectives, Methods, Speed studies - Definition of Spot Speed, time mean speed and space mean speed, Methods of conducting speed studies; Presentation of speed study data;

UNIT - II: Highway Capacity and Level of Service

Head ways and Gaps; Critical Gap; Gap acceptance studies. Basic definitions related to capacity; Level of service concept; Factors affecting capacity and level of service; Computation of capacity and level of service for two lane highways, multilane highways and freeways.

UNIT - III: Parking Studies and Traffic Accident Studies

Parking Studies and Traffic Safety, Types of parking facilities - on street parking and off-street Parking facilities, Parking studies and analysis, Accident studies and analysis; Causes of accidents-The Road, The vehicle, The road user and the Environment; Engineering, Enforcement and Education measures for the prevention of accidents.

UNIT - IV: Intersection Design

Type of Intersection, Conflicts at Intersection – At grade intersection – Uncontrolled, Channelization, signalized intersection - Design of Isolated Traffic Signal by Webster method, Types of Grade Separated Intersection and Design of Rotary.

UNIT - V: Traffic Regulation and Signals

Traffic Regulation and Environment: - Traffic Signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram Warrants for signalization, Signal Coordination methods. Detrimental effects of Traffic on Environment; Air pollution; Noise Pollution; Measures to curtail environmental degradation due to traffic

UNIT - VI: Intelligent Transportation Systems

Components of ITS, Traffic Management - Incident Management, Advanced vehicle control and safety systems, Electronic toll collection, Traveller Information System, Benefits and costs of ITS.

Text Books

1. Traffic Engineering and Transportation Planning, L. R. Kadiyali, 4th Edition, Khanna Publishers, 1991
2. Highway Engineering, S. K. Khanna & C.E.G Justo, 9th Edition, Nem Chand & Bros Publisher, 2012
3. Intelligent Transport Systems Standards, Bob Williams, 2008, Artech House Publishers

Reference Books

1. Traffic Engineering-Theory & Practice, Louis J. Pignataro, 2nd Edition, Prentice Hall Publication, 1973
2. Transportation Engineering-An introduction, C. Jotin Khistry, 3rd Edition, Prentice Hall Publication, 2002
3. Traffic Flow Fundamentals, A.D., Prentice Hall Inc., 1990, New Jersey.

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Professional Elective - III

INDUSTRIAL WASTEWATER MANAGEMENT

IV Year – I Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To impart the knowledge of industrial wastes and their pollution potential.
- To introduce manufacturing processes of different types of industries.
- To elucidate the high-level strategies adopted to deal with industrial effluents.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- characterise industrial effluents.
- identify relevant pre and primary treatment options for specific effluents.
- relate pollution problems to specific constituents of effluents and their removal.
- suggest pollution control strategies for food processing industries.
- suggest pollution control strategies for material manufacturing industries.
- draw up action plan for setting up a common effluent treatment plant.

Course Content

UNIT - I: Sources of Pollution

Physical, Chemical and Biological properties of Industrial Wastes – Differences between industrial and municipal wastewaters, difficulty to generalise industrial waste characteristics – Discontinuity and seasonality of some wastes) – Direct disposal, combined treatment, dedicated treatment – Effects of industrial effluents on sewers and treatment plants.

UNIT - II: Pre and Primary Treatment

Equalization, objectives, parameters that could be treated by equalisation – Proportioning, dilution with other effluents – Neutralization, mixing wastes – Oil Separation by Floatation, quiescent flotation and mechanically aerated floatation, types of solids that can be removed by floatation.

Waste Reduction – Volume Reduction, conservation of wastewater – Strength Reduction – Recirculation of industrial wastes.

UNIT - III: Waste Treatment Methods

Nitrification and De-nitrification, Aerobic biological methods, algal ponds – Phosphorous removal, chemical precipitation, Aerobic biological methods, algal ponds – Heavy metal removal, chemical precipitation, precipitation reactions – Membrane Separation Process – Air Stripping and Adsorption Processes– Special

Treatment Methods, ion exchange, advanced oxidation, distillation – Disposal of Treated Waste sludge – Disposal of Treated Wastewater.

UNIT - IV: Food Processing Industries

Manufacturing Processes, Characteristics and Composition of wastewater in the following industries; Dairy, Sugar, Fermentation (Brewery, Distillery, Pharmaceutical industry), Fisheries.

Flow diagrams for process and wastewater treatment, byproducts if any from wastewater treatment.

UNIT - V: Material Manufacturing Industries

Manufacturing Processes, Characteristics and Composition of wastewater in the following industries; Metal (Steel, mineral processing), Liquid (Petroleum Refineries), Fibre (Paper and Pulp, Flow diagrams for process and wastewater treatment, byproducts if any from wastewater treatment – Apparel Manufacturing Industries, Manufacturing Processes, Characteristics and Composition of wastewater in the following industries; Textiles, Tanneries – Energy Transformation Industries: Manufacturing Processes, Characteristics and Composition of wastewater in the following industries; Coal based power plants, Atomic Energy Plants, Flow diagrams for process and wastewater treatment, byproducts if any from wastewater treatment.

UNIT - VI: Effluent Treatment Plants

Joint Treatment of Raw Industrial wastewaters and Domestic Sewage – CommonEffluent Plants (CETPs) - (Location (Site and Process Selection) planning, plant design, commissioning)

Operation and Maintenance Problems- (fouling of equipment due to industrial wastes)

Economical aspects - (cost considerations and funding of projects, special requirements)

Text Books

1. Industrial Water Pollution Control, W. Wesley Eckenfelder Jr., McGrawHill.
2. Wastewater engineering - Treatment & Reuse, Metcalf and Eddy, TATA McGrawHill.

Reference Books

1. Liquid Waste of Industry - Theories, Practices & Treatment, N.L.Nemerow, Addison Wesley.
2. Environment Engineering, Peavy, Rowe & Tchobanoglous, McGrawHill.
3. Water and Wastewater Engineering Volume 1 (water supply and wastewater removal), Fair, Gayer and Okun, John Wiley and Sons.
4. Water and Wastewater Engineering Volume 2 (water purification and wastewater treatment and disposal, Fair, Gayer and Okun, John Wiley and Sons.

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Professional Elective - IV

ADVANCED DESIGN OF RC STRUCTURES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the design procedure for flat slabs and footings.
- To make understand the loading pattern and design procedure for silos and bunkers.
- To familiarize with I.R.C loads and their application on designing the R.C bridges.
- To introduce the design procedure of R.C water tanks.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design footings
- analyze and design the flat and grid slabs
- anayze and design cantilever and counter fort retaining wall
- design the R.C silos and bunkers.
- design R.C. deck slab bridges using I.R.C loadings.
- design elevated R.C water tanks.

Course Content

UNIT - I: Footings

Different types of footings – Design of isolated footing for axial and bending moments, Rectangular and circular footings subjected to axial loads only.

UNIT - II: Flat slab

Design of Flat slab - Direct design method -reinforcement detailing, Shear - beam shear and punching shear, Reinforcement detailing of flat slab.

UNIT - III: Retaining Walls

Types of retaining wall, Forces on retaining wall, stability requirements, Design of cantilever and design principles of counter fort Retaining walls.

UNIT - IV: Silos and Bunkers

Introduction – Concepts of loading and Design, design of Circular silos and rectangular R.C. bunkers.

UNIT - V: Bridges

Introduction to concrete bridges – IRC loadings, Deck Slab Bridge – Design concepts

UNIT - VI: Water Tanks

Design of R.C elevated circular and rectangular water tanks.

Text Books

1. Advanced Reinforced concrete structures, Varghese, Prentice Hall India Pvt. Ltd.
2. Design and Drawing of concrete structures, N. Krishnam Raju, University press 2005.

Reference Books

1. Reinforced concrete structures Vol.2, B.C.Punmia, Ashok Kumar Jain &Arun Kumar Jain. Laxmi publications Pvt.Ltd., New Delhi.
2. Essentials of Bridge engineering, D.Johnson Victor, Oxford and IBM publications Co.Ltd.
3. Reinforced concrete structures, I.C.Syal and Goel, S.Chand publishers.
4. All Relevant I.S. codes for Bridges IRC-6:2010 – Loading specifications IRC-112:2011 Design specifications For Water tanks BIS –IS-3370.

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Professional Elective - IV

HYDRAULIC STRUCTURES

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the design principles of hydraulic structures on permeable foundations.
- To impart knowledge on various types of dams and selection of suitable type depending on site conditions
- To familiarize with the design principles of irrigation structures

Course outcomes

Upon successful completion of the course, the students will be able to

- select a suitable location for a dam, the criteria for selecting a particular dam type
- analyze stability of gravity dams
- plan and design diversion head works
- design ogee spillways and energy dissipation works
- illustrate the design principles of irrigation canal structures

Course Content

UNIT - I: Reservoirs and Dams

Types of reservoirs, selection of site for reservoir, zones of storage of a reservoir, reservoir yield, estimation of capacity of reservoir using mass curve, types of dams, merits and demerits, factors affecting selection of type of dam, factors governing selecting site for dam.

UNIT - II: Gravity Dams

Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a low gravity dam, stability analysis, drainage galleries

UNIT - III: Diversion Head Works

Diversion Head works: Types of Diversion head works-diversion and storage head works, weirs and barrages, layout of diversion head works, components. causes and failure of hydraulic structures on permeable foundations, Bligh's creep theory, Khosla's theory, determination of uplift pressure, impervious floors using Bligh's and Khosla's theory, exit gradient, functions of u/s and d/s sheet piles.

UNIT - IV: Spillways

Spillways: Types, design principles of Ogee spillways, types of spillways crest gates. Energy dissipation below spillways-stilling basin and its appurtenances

UNIT - V: Canal Regulation Works

Canal regulation works: Head and Cross Regulator, Principles of design of distributary and head regulators, canal outlets, proportionality, sensitivity and flexibility

UNIT - VI: Cross Drainage Works

Cross Drainage works: Types, selection of site, design principles of aqueduct, siphon aqueduct and super passage.

Text Books

1. Irrigation and water power engineering, B.C. Punmia, Pande B.B Lal, Ashok Kumar Jain & Arun Kumar Jain, sixteenth edition, Laxmi publications.
2. Irrigation Water Resources and Water Power Engineering, P.N.Modi, seventh edition, Standard Book House

Reference Books

1. Water resources engineering principles and practice, Satyanarayana Murthy. Challa, revised second edition, New Age International Publishers
2. Irrigation engineering and hydraulic structures, S.K Garg, thirty forth edition, Khanna Publishers.

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Professional Elective - IV

GEOSYNTHETICS

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with geosynthetics.
- To impart knowledge on designing the geosynthetic material for various functions.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain geosynthetics.
- interpret the test methods of different materials of geosynthetics.
- explain the design considerations for different materials of geosynthetics.

Course Content

UNIT - I: Introduction

Overview of Geosynthetics, types – geotextiles, geogrids, geonets, geomembranes, geosynthetic clay liners and geocomposites – their manufacturing

UNIT - II: Geotextiles

Properties and test methods – functions – designing for separation, reinforcement, stabilization, filtration, drainage.

UNIT - III: Geogrids

Properties and test methods – design for geogrid reinforcement for roads, reinforced wall, foundation, slopes and embankments.

UNIT - IV: Geonets and Geosynthetic clay liners (GCL)

Geonets: Properties and test methods – design for geonet drainage in view of environmental and transportation application

Geosynthetic clay liners (GCL): Properties and test methods, designing with GCL as single and composite liners – GCL on slopes

UNIT - V: Geomembranes

Properties and test methods – design considerations of geomembrane in pond, canal, reservoirs and solid liners

UNIT - VI: Geocomposites

Geocomposites in separation, reinforcement, filtration and drainage

Text Books

1. Designing with Geosynthetics, Koerner, R.M, Prentice Hall, New Jersey, USA, 4th edition, 1999.
2. An Introduction to Soil Reinforcement & Geosynthetics, G L Siva Kumar Babu, 1st edition, University press

Reference Books

1. Soil Reinforcement with Geotextiles,Jewell, R.A.,Special Publication No. 123, CIRIA, Thomas Telford. London, UK, 1996.
2. Geosynthetics - New Horizons, Eds. G.V. Rao, PK Banerjee, J.T. Shahu, G.V. Ramana, Asian Books Private Ltd., New Delhi, 2004.

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Professional Elective - IV

DISASTER PREPAREDNESS AND PLANNING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide an exposure to disasters, their significance and types.
- To familiarize with impacts of disaster key skills.
- To impart the knowledge on different approaches of Disaster risk reduction.

Learning Outcomes

Upon successful completion of the course, students will be able to

- differentiate the types of disasters, causes and their impact on environment and society.
- analyze relationship between development and disasters.
- explain the process of risk management.
- assess vulnerability and various methods of risk reduction measures as well as mitigation.

Course Content

UNIT - I: Introduction

Concepts and definitions: disaster, disaster Management,hazard, vulnerability, risk, capacity, mitigation. Types of Disasters, five priorities for action, relationship between disaster and human development, Disaster Management cycle,

UNIT - II: Disasters classification

Disasters classification; Natural disasters –floods, Drought, earthquake, cyclone, landslide. Manmade disasters –industrial pollution, nuclear radiation, chemical spills, bio terrorism, transportation accidents. Hazard and vulnerability profile of India.

UNIT - III: Disaster Impacts

Introduction, Life and livestock loss, Habitation, agricultural and livelihood loss, Additional health hazards, Contamination of drinking water sources, impact on children, Environmental loss. Impacts of climate change, greenhouse gases.

UNIT - IV: Disaster risk reduction

Disaster management cycle- its phases,prevention, mitigation, preparedness, relief & recovery; structural and non-structural measures, basic strategies and practices of disaster risk reduction,global policies and practices, risk management framework, vulnerabilityand capacity assessment.

UNIT - V: Education and Community Preparedness:

Education in disaster risk reduction-Essentials of school disaster education-Community capacity and disaster resilience-Community based disaster recovery -Community based disaster management and social capital-Designing resilience buildingcommunity capacity for action

UNIT - VI: Role of Technology in Disaster Management

Disaster management for infra structures, mitigation program for earthquakes – flowchart, geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training- transformable indigenous knowledge in disaster reduction.

Text Books

1. Disaster Management – Global Challenges and Local Solutions, Rajib shah & R R Krishnamurthy, 2009, Universities press.
2. Disaster Science & Management, Tushar Bhattacharya, 2012, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Reference Books

1. Disaster Management – Future Challenges and Opportunities, Jagbir Singh, 2007, I K International Publishing House Pvt. Ltd.
2. Disaster management, Ghosh G.K, 2006, APH Publishing Corporation.
3. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf).

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Open Elective - IV

DISASTER MANAGEMENT

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with disaster occurrence, strategies and remedial measures.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the aspects of disaster management and various types of disasters.
- assess and evaluate the impact of hazards on structures.
- identify the vulnerability conditions against disasters.
- adopt the rehabilitation procedures.

Course Content

UNIT - I: Introduction

Concept of Disaster Management.Types of Disasters.Disaster mitigating agenciesand their organizational structure at different levels.

UNIT - II: Overview of Disaster Situations in India

Vulnerability of profile of India and Vulnerability mapping including disaster – prone areas, communities, places. Disaster preparedness – ways and means; skillsand strategies; rescue, relief reconstruction. Case Studies: Lessons andExperiences from Various Important Disasters in India

UNIT - III: Flood and Drought Disaster

Raising flood damage, assessing flood risk, flood hazard assessment, flood impactassessment, flood risk reduction options. Drought and development, reliefmanagement and prevention, drought mitigation and management-integratingtechnology and people.

UNIT - IV: Landslide and Earthquake Disaster

Land slide hazards zonation mapping and geo environmental problems associatedwith the occurrence of landslides. The use of electrical resistivity method in thestudy of landslide.Causes and effects of earth quakes. Secondary effects. Criteria for earthquake resistant design.

UNIT - V: Cyclone and Fire Disaster

Cyclone occurrence and hazards.Cyclone resistant house for coastal areas.Disaster resistant construction role of insurance sector.Types of fire. Fire safetyand fire fighting method, fire detectors , fire extinguishers.

UNIT - VI: Rehabilitation

Rehabilitation programmes, Management of Relief Camp, information systems &decision making tools

Text Books

1. Disaster Management – Future Challenges and Opportunities, Jagbir Singh, 2007, I K International Publishing House Pvt. Ltd.
2. Disaster Management – Global Challenges and Local Solutions, Rajib shah & R R Krishnamurthy, 2009, Universities press.

Reference Books

1. Disaster Science & Management, Tushar Bhattacharya, 2012, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Disaster Management, H K Gupta, 2003, Universities press.
3. Natural Disaster management, Jon Ingleton, Leigh Trowbridge,1999, Tudor Rose Holdings Ltd.

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Open Elective - IV

REPAIR AND RETROFITTING TECHNIQUES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with durability aspects, quality of concrete causes of deterioration.
- To impart the knowledge on inspection and assessment of distressed structures, strengthen measures and demolition procedures.
- To familiarize with various concrete materials for repairs, and various precautions during retrofitting.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify and evaluate the degree of damage in structures.
- explain the cause of deterioration of concrete structures.
- point out the causes of distress in concrete
- explain the concept of Serviceability and Durability.
- assess damage to structures and select suitable retrofitting and repair techniques
- apply different materials for repairing

Course Content

UNIT - I: Assessment, Maintenance and Repair Strategies

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT - II: Serviceability and Durability of Concrete

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness and cracking.

UNIT - III: Materials for Repair

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete.

UNIT - IV: Techniques for Repair and Protection Methods

Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Expoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and catholic protection. Engineered demolition techniques for dilapidated structures.

UNIT - V: Repair, Rehabilitation and Retrofitting of Structures

Repairs to overcome low member strength.Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

UNIT - VI: Work Site Safety

General safety-vehicles, eye and ear protection, clothing; Tool safety-drills and bits, power saws, power mixers, ladders, screwdrivers and chisels; co-worker safety.

Text Books

1. Concrete Structures, Materials, Maintenance and Repair, Denison Campbell, Allen and Harold Roper, edition-1991, Longman Scientific and Technical UK.
2. Repair of Concrete Structures, Allen R.T. & Edwards S.C, edition-1991 Blakie and Sons, UK.

Reference Books

1. Concrete Technology-Theory and Practice, M.S.Shetty, Edition-2006 S.Chand and Company.
2. Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Ravishankar.K, Krishnamoorthy.T.S, Edition-2004, Allied Publishers.
3. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers Edition-2004.
4. Hand book on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, Edition-2002.
5. Repair and protection of concrete structures, Noel P.Mailvaganam, Edition-1991 CRC Press London.

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Open Elective - IV

MODERN OPTIMIZATION TECHNIQUES

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the concepts of evolutionary optimization
- To introduce the principles of soft computing optimization algorithes such as Genetic Algorithm, Particle Swarm Optimization, Differential Evolution and Ant Colony Optimization.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish the various optimization techniques.
- describe the concepts of various optimization techniques.
- develop suitable algorithms for the implementation of optimization techniques.
- apply suitable optimization technique to solve various engineering optimization problems

Course Content

UNIT - I: Definition-Classification Of Optimization Problems

Unconstrained and Constrained optimization-Optimality conditions, Evolution in nature-Fundamentals of Evolutionary algorithms- Evolutionary Strategy and Evolutionary Programming.

UNIT - II: Genetic Algorithm

Basic concepts- search space- working principle -encoding-fitness function - Genetic Operators-Selection: Roulette-wheel, Boltzmann, Tournament, Rank and Steadystate-Elitism- Crossover: single-pint, two-point, multi-point, uniform, matrix and cross over rate, mutation, mutation rate.

UNIT - III: Variations of GA & PSO

Variations of GA: Adaptive GA and Real coded GA - Issues in GA implementation-Particle Swarm Optimization: Introduction- Fundamental principles of Particle Swarm Optimization-Velocity Updating-Advanced operators-Parameter selection.

UNIT - IV: Variations of PSO

Implementation issues-Convergence issues, Multi-objective PSO (Dynamic neighbourhood PSO-Vector evaluated PSO)-Variations of PSO: weighted, repulsive, stretched, comprehensive learning, combined effect PSO and clonal PSO.

UNIT - V: Differential Evolution

Introduction-Fundamental principles of Differential Evolution- different strategies of differential evolution-function optimization formulation-mutation and crossover operators-estimation and selection-Discrete Differential Evolution.

UNIT - VI: Ant Colony Optimization

Introduction-Fundamental principles of Ant colony optimization-Ant foraging behaviour-initialization-transition strategy-pheromone update rule- applications.

Text Books

1. Kalyanmoy Deb, "Multi objective optimization using Evolutionary Algorithms",John Wiley and Sons, 2008.
2. E. Goldberg, Genetic Algorithms in search, Optimization and machine learning,1989
3. Particle Swarm Optimization, An overview by Riccardo Poli, James Kennedy,Tim Blackwell, pringer
4. Differential Evolution, A Practical Approach to Global Optimization, Authors:Price, Kenneth, Storn, Rainer M., Lampinen, Jouni A. , Springer
5. Ant Colony Optimization by Marco Dorigo, Thomas Stutzle, MIT Press.

Reference Books

1. "Modern optimization techniques with applications in Electric Power Systems", Soliman Abdel Hady, Abdel Aal Hassan Mantawy, Springer,2012.
2. 'Introduction to Genetic Algorithms", M. Mitchell, Indian reprint, MIT press Cambridge, 2nd edition, 2002.
3. R.C. Eberhart, Y.Sai and J. Kennedy, Swarm Intelligence , The Morgan Kaufmann Series in Artificial Intelligence, 2001.
4. "Biomimicry for optimization, Control and Automation, K.M. Passino, Springer-Verlag, London, UK, 2005.
5. "New Optimization Techniques in Engineering, G. C. Onwubolu, & B. V. Babu,Springer- Verlag Publication, Germany, 2003.

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Open Elective - IV

ELECTRICAL POWER UTILIZATION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the mechanics of train movement.
- To impart knowledge on various heating methods and laws of illumination.
- To familiarize with the concepts of refrigeration and air-conditioning.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the appropriate type of traction system.
- select a suitable method of heating for a given application.
- design an illumination system.
- calculate the required tonnage capacity for a given air-conditioning system.
- select a suitable charging method.
- evaluate domestic wiring connection and debug any faults occured.

Course Content

UNIT - I: Electrical Traction

Features of an Ideal Traction System, Systems of Electrical Traction, Traction Supply System, Mechanism of Train Movement, Speed- Time Curve, Traction Motors, Tractive Effort and Horse Power, Speed Control Schemes, Electric Braking,Recent Trends in Traction.

UNIT - II: Electric Heating

Classification, Heating Element, Losses in Oven and Efficiency, Resistance Furnace, Radiant Heating, Induction Heating, High Frequency Eddy Current Heating, Dielectric Heating, Arc Furnace, Heating of Furnace, Electric Welding, Methods and Equipments.

UNIT - III: Illumination

Radiant Energy, Terms and Definitions, Laws of Illumination, Polar Curves, Photometry, MSCP, Integrating Sphere, Luminous Efficacy, Electrical Lamps, Design of Interior and Exterior Lighting Systems, Illumination Levels for Various Purposes, Light Fittings, Factory Lighting, Flood Lighting, Street Lighting, Energy Conservation in Lighting.

UNIT - IV: Air Conditioning and Refrigeration

Control of Temperature, Protection of Motors, Simple Heat-Load and Motor Calculations, Various Types of Air Conditioning, Functioning of Complete Air Conditioning System, Type of Compressor Motor, Cool Storage, Estimation of Tonnage Capacity and Motor Power.

UNIT - V: Electro-Chemical Processes

Electrolysis – Electroplating – Electro deposition – Extraction of metals current, Efficiency - Batteries – types – Charging Methods.

UNIT - VI: Basics of Domestic Electrical Wiring

Types of Cables, Flexible Wires Sizes and Current Capacity, Use of Fuse, MCB and MCCB (Working and Construction), Idea about Megger, Earthling – Domestic and Industrial.

Text Books

1. "Utilisation of Electric Energy" Garg and Girdhar, 1982, Khanna Publisher.
2. "Art and Science of Utilization of Electrical Energy", Pratab H., Second Edition, Dhanpat Rai and Sons, New Delhi.

Reference Books

1. "Generation, Distribution and Utilization of Electrical Energy",Wadhwa C.L., 1993, Wiley Eastern Limited,
2. "Electric Energy Utilization and Conservation", S.C.Tripathy, 1993, Tata McGraw Hill.
3. "Utilization of Electric Power", R.K. Rajaput,Laxmi Publications, 1st Edition, 2007.
4. "Utilization of Electric Power", N.V.Suryanarayana, New Age International, 2005.
5. "Generation, Distribution and Utilization of Electrical Energy, C.L.Wadhwa, New Age International, 4th Edition, 2011.
6. Refrigiration and Air-conditioning, M. Prasad, Wiley Eastern Ltd., 1995 .
7. "Utilization of Electrical Energy", Taylor E. Openshaw, 1968, Orient Longman.
8. "Utilization of Electric Power and Electric Traction", Gupta J. B., 2002, S. K. Kataria and Sons.

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Open Elective - IV

GREEN ENGINEERING

IV Year – I Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To impart the knowledge needed to minimize impacts of products, processes on environment for sustainable development.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- evaluate the impact of technology on environment
- compare biological ecology to industrial ecology
- design eco friendly product.
- create sustainable products, facilities, processes and infrastructure
- asses the life cycle of a product to evaluate its impact on energy and materials use
- determine the effects of air and water quality

Course Content

UNIT - I: Introduction

Humanity and technology, the concept of sustainability, quantifying sustainability, industrial ecology

UNIT - II: Frame work for green engineering

The relevance of biological ecology to industrial ecology, metabolic analysis, technology and risk, the social dimensions of industrial ecology.

UNIT - III: Implementation

Technological product development,design for environment and sustainability-customer products- buildings and infrastructure.

UNIT - IV: Life Cycle Assessment

An introduction to life cycle assessment, the LCA impact and interpretation stages, streamlining the LCA process.

UNIT - V: Analysis of Technological Systems-material flow and energy

Systems Analysis, industrial ecosystems, material flow analysis, energy and industrial ecology,

UNIT - VI: Analysis of Technological Systems-air-water

Air quality impacts, carbon cycles and energy balance, water quality impacts, urban industrial ecology, modelling in industrial ecology.

Text Books

1. T E Graedel, Braden R Allenby "Industrial ecology and sustainable engineering" Prentice Hall.
2. David T. Allen, David R Shonnard "Sustainable Engineering Concepts, Design and Case Studies" Prentice Hall.

References Books

1. Bradley A. Striebig, Adebayo A. Ogundipe, Maria Papadakis "Engineering applications in sustainable design and development" Cengage Learning.
2. Anastas, Paul T, Zimmerman, Julie B, "Innovations in Green Chemistry and Green Engineering", Springer, First Edition.
3. Daniel A. Vallero, Chris Brasier, "Sustainable Design: The Science of Sustainability and Green Engineering", Wiley, First Edition.

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Open Elective - IV

NON DESTRUCTIVE EVALUATION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of various NDE techniques to identify the defect in a mechanical elements.

Course Outcomes

Upon successful completion of the course, the students will be able to

- choose a suitable non destructive method to find the defect in the given mechanical components using radiography, ultrasonic test, magnetic particle test etc.,

Course Content

UNIT - I: Introduction to Non-Destructive Testing

Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography

UNIT - II: Ultrasonics Test

Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III: Liquid Penetrant Test

Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing

UNIT - IV: Magnetic Particle Test

Magnetic Materials, Magnetization of Materials, Demagnetization of Materials,Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT - V: Eddy Current Test

Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing

UNIT - VI: Industrial Applications of NDE

Span of NDE Activities Railways, Chemical Industries, Automotive Industries, NDE of pressure vessels, castings, welded constructions.

Text Books

1. Non-Destructive Test and Evaluation of Materials, J Prasad, GCK Nair, TMH Publishers.
2. Ultrasonic Testing by Krautkramer and Krautkramer.
3. Non-Destructive Testing, Warress, JMc Gonmade.

References Books

1. Ultrasonic inspection training for NDT: E. A. Gingel, Prometheus Press.
2. ASTM Standards, Vol 3.01, Metals and alloys.
3. Non-Destructive, Hand Book – R. Hamchand.

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Open Elective - IV

CYBER PHYSICAL SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To prototype the Smart objects and provides a holistic understanding of development Platforms, connected products of Internet of things (IoTs).
- To familiarize with real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop prototypes using appropriate Platforms of internet-connected products.
- assess and improve the reliability & security of a simple Cyber-Physical System.
- differentiate various methodologies and tools of automatic synthesis of controls and software

Course Content

UNIT - I: Introduction to Cyber physical System

Cyber-Physical Systems (CPS); history; key features; CPs design challenges; model-based design and design methodologies; simulation, validation, verification, and synthesis; platform-based design and contract-based design.

UNIT - II: Modeling

Introduction to models of computation; languages and tools for system design; mathematical background; notions of complexity and computability, finite state machines; synchronous/reactive model.

UNIT - III: Analysis

Cyber-Physical System requirements (functional, extra-functional, safety, liveness, reliability, real-time); specification languages; temporal logic; overview of requirement analysis and validation techniques, core engines for algorithmic system verification;

UNIT - IV: Introduction to Internet of Things

Definition and evolution of IoT, architecture of IoT, resource management, data management and analytics, security issues, identity management and authentication, privacy, standardization and regulatory limitations, opportunities for IoT.

UNIT - V: IoT Enabling Technologies

Wireless Sensor Networks: Overview, history, the node, connecting nodes, networking nodes. securing communication- standards. cloud computing, Big data analysis, communication protocols, wireless communication protocols, wireless communication protocols and application protocols.

UNIT - VI: Use cases and IoT applications

Home automation, smart building, smart health, location tracking, environment, energy, agriculture, smart cities and other IoT electronic industries.

Text Books

1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems, A Cyber-Physical Systems Approach," 2nd Edition, http://LeeSeshia.org, 2015.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.

Reference Books

1. Arshdeep Bahga, Vijay Madisetti "Internet of Things - A Hands-on Approach", Published by Arshdeep Bahga & Vijay Madisetti, 1st Edition.
2. Dieter Uckelmann, Mark Harrison Florian, Michahelles "Architecting the Internet of things", Springer-Verlag Berlin Heidelberg, 1st Edition.

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Open Elective - IV

SIGNALS AND SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of signals and systems.
- To introduce various transform techniques on signals.
- To develop an understanding of sampling and correlation techniques on signals.

Course Outcomes

Upon successful completion of the course, the students will be able to

- classify the signals and various operations on signals.
- perform Fourier analysis on the signals.
- analyze the various systems.
- perform correlation operational on signals.
- apply the various sampling techniques on continuous time signals.
- analyze the various continuous time signals through transformation (Fourier and Laplace) techniques.

Course Content

UNIT - I: Signal Analysis

Classification of signals, basic operations on signals-amplitude and time scaling, time shifting, addition and multiplication, introduction to elementary signals-unit step, impulse, ramp, parabolic, rectangular, triangular, sinusoidal, exponential, signum, sinc and gaussian functions.

UNIT - II: Fourier Series Representation of Continuous Time Signals

Trigonometric and exponential Fourier series, relationship between trigonometric and exponential Fourier series, representation of a periodic function by the Fourier series over the entire interval, convergence of Fourier series, alternate form of trigonometric series, symmetry conditions-even and odd, complex Fourier spectrum.

UNIT - III: Fourier Transform

Representation of an arbitrary function over the entire interval: Fourier transform, Fourier transform of some useful functions and periodic function, properties of Fourier transform, energy density spectrum, Parseval's theorem.

Sampling: Sampling theorem for band limited signals- explanation, reconstruction of signal from samples, aliasing, sampling techniques- impulse, natural and flat top sampling.

UNIT - IV:LTI Systems

Properties of systems, Linear Time Invariant (LTI) system, response of LTI system- convolution integral, properties of LTI system, transfer function and frequency response of LTI system.

Signal Transmission Through LTI Systems: Filter characteristics of LTI systems, distortion less transmission through LTI system, signal bandwidth, System bandwidth, ideal LPF, HPF and BPF characteristics, causality and physical realizability- Paley-Wiener criterion, relationship between bandwidth and rise-time.

UNIT - V: Correlation of Continuous Time Signals

Cross correlation and auto correlation of continuous time signals (finite and nonfinite energy signals), relation between convolution and correlation, properties of cross correlation and autocorrelation, power density spectrum, relation between auto correlation function and energy/power spectral density function.

UNIT - VI: Laplace Transform

Laplace transform of signals, properties of Region of Convergence (ROC), unilateral Laplace transform, properties of unilateral Laplace transform, inversion of unilateral and bilateral Laplace transform, relationship between Laplace and Fourier Transforms.

Text Books

1. B.P.Lathi, "Signals, Systems &Communications", BS Publications, 2003 (Units I-VI).
2. A.V. Oppenheim, A.S. Willsky and S.H.Nawab, "Signals and Systems",PHI, 2nd Edition (Units I, III, VI)

Reference Books

1. Simon Haykin and Van Veen, "Signals &Systems", Wiley, 2nd edition
2. Michel J. Robert , "Fundamentals of Signals and Systems", TMGH Int. Edition, 2008
3. C.L.Philips, J.M. Parr and Eve A. Riskin, "Signals, Systems and Transforms", Pearson Education, 3rd Edition, 2004.

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Open Elective - IV

DIGITAL FORENSICS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide a comprehensive overview of digital forensic process.
- To familiarize with the different roles a computer in crime investigation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- formulate a Digital Forensic Process
- employ fundamental computer theory in the context of computer forensics practices
- apply the principles of effective digital forensics investigation techniques
- explain the role of digital forensics in the field of information assurance and information security
- evaluate the effectiveness of available digital forensic tools
- outline the file storage mechanisms of DOS systems
- examine computer incidents in crime scene

Course Content

UNIT - I: Introduction to Digital Forensics

What is Computer Forensics?, Differences between Computer Forensics and Digital Forensics, History of Digital Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists, Types of Computer Forensics Technology.

UNIT - II: Computer Forensics Evidence and Capture

Data Recovery, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution, Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options, Obstacles, Types of Evidence, the Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody.

UNIT - III: Duplication and Preservation of Digital Evidence, Computer Image Verification and Authentication, Processing Crime and Incident Scenes: Identifying Digital Evidence, Collecting Evidence in Private-Sector Incident Scenes, Securing a Computer Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence, Obtaining a Digital Hash, Reviewing a Case.

UNIT - IV: Digital Forensics Analysis and Validation

Determining what data to collect and analyze, Validating Forensic data, Data-Hiding Techniques, Examining Encrypted Files, Recovering Passwords, Performing Remote Acquisitions, Virtual Machines, Network Forensics and performing Live Acquisitions, Email Investigations, Mobile Device Forensics.

UNIT - V: Current Digital Forensics Tools

Types of Forensics Tools, Tasks performed by Forensic Tools, Tool Comparisons, Software Tools – Command-line Forensics Tools, UNIX/Linux Forensics Tools, other GUID Forensics Tools, Hardware Tools – Forensic Workstations, Using a Write-Blocker, Validating and Testing Forensic Software - Using National Institute of Standards and Technology (NIST) Tools, Using Validation Protocols.

UNIT - VI: Working with Windows and DOS Systems

File Systems, exploring Microsoft File Structures, examining NTFS disks, whole Disk Encryption, Windows Registry, Microsoft Start-up Tasks, MS-DOS Start-up Tasks, and Virtual Machines.

Text Books

1. John R.Vacca, "Computer Forensics: Computer Crime Scene Investigation", 2nd edition, Charles River Media.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", 3rd edition, CENGAGE Learning.

Reference Books

1. Tony Sammes and Brian Jenkinson, "Forensic Computing, A Practitioners Guide", 1st edition. Springer
2. Christopher L. T. Brown, "Computer Evidence: Collection and Preservation", 2nd edition, Firewall Media.
3. Jesus Mena, "Homeland Security, Techniques and Technologies", 1st edition Firewall Media.

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Open Elective - IV

BUSINESS INTELLIGENCE AND DECISION SUPPORT SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To identify the process of decision making and use of model for decision making.
- To use various visualization tools for delivery of knowledge.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the need of Business Intelligence
- explain the process of decision making
- use mathematical model for decision making
- compare simple linear regression model with multiple linear regression model for prediction.
- choose a marketing model to design sales territory
- construct charts, graphs and widgets to deliver the knowledge for decision makers

Course Content

UNIT - I: Introduction to Business Intelligence

Effective and timely decisions, Data, information and knowledge, Role of mathematical models, Business intelligence architectures, Ethics and business intelligence.

UNIT - II: Decision support systems

Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system.

UNIT - III: Mathematical models for decision making

Structure of mathematical models, Development of a model, Classes of models.

Regression: Structure of regression models, Simple linear regression, Multiple linear regression.

UNIT - IV: BI Applications

Marketing Models: Relational Marketing, Sales force Management, Business case studies.

UNIT - V: Data envelopment analysis

Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices.

UNIT - VI: Knowledge Delivery

Visualization, Scorecards and Dashboards, Geographic Visualization, Integrated analytics, Considerations: Optimizing the presentation for the Right message.

Text Books

1. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications.
2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2^{nd} edition, Morgan Kaufman Publications.

Reference Books

1. Efraim Turban, Jay E Aronson, Teng-Peng Liang, Ramesh Sharda, "Decision Support and Business Intelligence Systems", 8^{th} Edition, Pearson.
2. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 2^{nd} edition, Morgan Kaufmann Publishers.
3. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap: The complete Project Life Cycle of Decision Making", 1^{st} edition, Addison Wesley.
4. Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw- Hill.

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Open Elective - IV

ADHOC AND SENSOR NETWORKS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To acquire fundamental concepts of ad hoc networks.
- To learn design considerations of wireless sensor networks.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- evaluate architecture and protocols in adhoc and wireless sensor networks.
- identify applications of adhoc and WSN's.
- illustrate wireless sensor networks design aspects.
- synthesize routing protocols for adhoc wireless networks.
- outline Transport layer and security protocols for Ad hoc wireless networks.
- summarize layer wise functionalities of wireless sensor networks.
- describe MAC protocols in adhoc and WSN's.

Course Content

UNIT - I: Introduction

Fundamentals of wireless communication technology, the electromagnetic spectrum, radio propagation mechanisms, characteristics of the wireless channel.Ad hoc wireless networks: introduction, cellular and Ad hoc wireless networks, applications of ad-hoc networks, issues in ad hoc wireless networks.

UNIT - II: MAC Protocols for Adhoc Wireless Networks

Issues in designing a MAC protocol for ad hoc wireless networks, classifications of MAC protocols, Contention based protocols.

UNIT - III: Routing protocols for Adhoc Wireless Networks

Issues in designing a routing protocol for ad hoc wireless networks, classifications of routing protocols, table-driven routing protocols, on-demand routing protocols.

UNIT - IV: Transport layer and Security Protocols for Adhoc Wireless Networks

Introduction, Issues, design goals, classification of transport layer solutions, TCP over ad hoc wireless networks: TCP-F, TCP-ELFN, TCP-BUS, ATCP, split-TCP. Network security attacks.

UNIT - V: Sensor Networks Design Considerations-I

Introduction, energy consumption, sensing and communication range, design issues, localization scheme, clustering of SN's, MAC layer, Applications of wireless sensor networks.

UNIT - VI: Sensor Networks Design Considerations-II

Routing layer, flat versus hierarchical, operation-based protocols, location-based protocols, high level application layer support.

Text Books

1. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks: Theory and Applications", 2^{nd} Edition, World Scientific Publications, 2011.
2. C. Siva Ram Murthy, B.S. Manoj "Ad Hoc wireless networks: Architectures and protocols ", Pearson, 2017.

Reference Books

1. Prasant Mohapatra and Srihanamurthy, "Ad Hoc Networks Technologies and Protocols", Springer, Springer International Edition, 2009.
2. Subir kumar sarkar, C. Puttamadappa, T.G.Basavaraju, "Ad hoc mobile wireless networks:principles, protocols and applications", Taylor & Francis India Pvt Ltd - New Delhi, 2007.
3. Jagannathan, sarangapani, "wireless ad hoc and sensor networks protocols, performance, and control", CRC press, 2007.

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Open Elective - IV

INFORMATION RETRIEVAL SYSTEMS

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To provide the foundation knowledge in information retrieval.
- To familiarize about different applications of information retrieval techniques in the Internet or Web environment.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify basic theories in information retrieval systems.
- identify the analysis tools as they apply to information retrieval systems.
- understand the problems solved in current IR systems.
- describes the advantages of current IR systems.
- understand the difficulty of representing and retrieving documents.
- understand the latest technologies for linking, describing and searching the web.

Course Content

UNIT - I: Introduction to Information Storage and Retrieval System

Introduction, Domain Analysis of IR systems and other types of Information Systems, IR System Evaluation. Introduction to Data Structures and Algorithms related to Information Retrieval: Basic Concepts, Data structures, Algorithms.

UNIT - II: Inverted files

Introduction, Structures used in Inverted Files, Building Inverted file using a sorted array, Modifications to Basic Techniques.

UNIT - III: Signature Files

Introduction, Concepts of Signature Files, Compression, Vertical Partitioning, Horizontal Partitioning.

UNIT - IV: New Indices for Text

PAT Trees and PAT Arrays: Introduction, PAT Tree structure, Algorithms on the PAT Trees, Building PAT trees as PATRICA Trees, PAT representation as arrays.

UNIT - V: Stemming Algorithms

Introduction, Types of Stemming Algorithms, Experimental Evaluations of Stemming to Compress Inverted Files.

UNIT - VI: Thesaurus Construction

Introduction, Features of Thesauri, Thesaurus Construction,Thesaurus construction from Texts, Merging existing Thesauri.

Text Books

1. William B. Frakes, Ricardo Baeza-Yates, "Information Retrieval: Data Structures and Algorithms", Prentice Hall.
2. Ricardo Baeza-Yates, Bertheir Ribeiro-Neto, "Modern Information Retrieval", Pearson Education.
3. Robert R. Korfhage, "Information Storage and Retrieval", John Wiley & Sons.

Reference Books

1. Gerald Kowalski, Mark T Maybury, "Information Storage and Retrieval Systems-Theory and Implementation", 2nd edition, Kluwer Academic Press, 1997.
2. David A. Grossman, Ophir Frieder, "Information Retrieval:Algorithms and Heuristics", 2nd edition, Springer.

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Open Elective - IV

FUZZY LOGIC

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart the knowledge of fuzzy set theory and its applications in Engineering.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between crisp set and fuzzy set.
- compose the operations on fuzzy sets to characterize the belongingness of elements in the sets
- construct fuzzy relations to draw inferences
- illustrate the methods of defuzzification to drive the control mechanism.
- apply fuzzy logic to control automatic engineering systems.

Course Content

UNIT - I: Crisp Sets Vs Fuzzy Sets

Crisp sets an overview, Concept of fuzziness, the notion of Fuzzy sets, basic concepts of fuzzy sets.

UNIT - II: Operations of Fuzzy Sets

Fuzzy set operations-fuzzy complement, fuzzy union, fuzzy intersection, combinations of operations.

UNIT - III: Fuzzy Relations

Fuzzy Cartesian product ,Fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, lamda cut for fuzzy relations and composition, Fuzzy tolerance and equivalence relations.

UNIT - IV: Fuzzification and Defuzzification

Features of membership function, fuzzification, defuzzification to crisp set, Defuzzification to scalars(centroid method, centre of sums method, mean of maxima method).

UNIT - V: Fuzzy Logic

Introduction to fuzzy logic, Crisp connectives vs Fuzzy logical connectives, Approximate reasoning.

UNIT - VI: Applications of Fuzzy Systems

Fuzzy Control System, Control System Design Problem, Simple Fuzzy Logic Controller, general applications of fuzzy logic(washing machine, air conditioner controller).

Text Books

1. Timothy J.Ross., Fuzzy Logic with Engineering Applications - Second Edition, Wiley Publications, 2007, New Delhi.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, Neural networks, Fuzzy logic, and genetic algorithms synthesis and applications- – Prentice-Hall of India private limited, 2008, New Delhi.

Reference Books

1. H.J. ZIMMERMAN, Fuzzy set theory and its applications, 4th edition — SPRINGER, 2006. New Delhi.
2. Recommended Text S.Nanda and N.R.Das "Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi.

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Optional Elective - VII

PROJECT SCHEDULING AND CONTRACTS

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the knowledge on contract documents and specifications.
- To illustrate the Methodology of scheduling for activities and resources.
- To distinguish scheduling methods and contracts.
- To address the need of tender, estimation and bidding process.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the role of key stake holders in construction projects.
- apply available techniques for scheduling.
- evaluate event time probabilities and activity durations.
- distinguish the scope of construction contracts.
- develop pre- qualification process for construction projects.
- determine the estimation and bidding process from contractor.

Course Content

UNIT - I: Introduction to Contracts

Contract- Study of Construction Drawings & Specifications, details of project- role of project manager and estimator, Schedule of Meetings-Superintendent and Subcontractors, and Meeting with the client, contractor and the Architect.

UNIT - II: Physical Creation of the Schedule

Software tools available – Primavera, Microsoft Project , Division of Project into Subnet works, Develop Responsibility Codes, Information Codes, Specific Subnet works, Draft the Logic Diagram, Number the Activities , Tie the Subnets Together, Computerization, Refinement , Scheduler Refinement, The Circular Path, Float Analysis, Refinement with Superintendent and

UNIT - III: Scheduling Methods

Program Evaluation and Review Technique (PERT) Introduction, PERT Defined, Computing PERT Durations, Calculating PERT Event Times and Probabilities, Advantages and Disadvantages of PERT, Linear Scheduling Method (LSM): Definitions, Elements of LSM Schedules, Preparation of LSM Schedules, Use of LSM Schedules, Advantages of LSM Schedules, advantages of LSM Schedules

UNIT - IV: Construction Contracts

Contract Document, The Contract Drawings, The Specifications, The General Conditions of Contract (GCC), The Special Conditions of Contract (SCC),The Bill of Quantities (BOQ).

Classification of Engineering Contracts: Separated Contract, Management Contract, Integrated Contract, Discretionary Contract.

UNIT - V: Pre-qualification Process

Pre-qualification Process, Notice Inviting Tender, Submission of Bids, Analysis of Submitted Tenders, Basis for Evaluation and Acceptance, Letter of Intent, Work Order, Agreement , CPWD Contract Conditions, FIDIC form of Contract Agreement, Need and Principles of FIDIC Contracts, Salient Features of FIDIC form of Contract, New Engineering Contract (NEC).

UNIT - VI: Contractor's Estimation and Bidding Process

Pre-qualification Process, Study of Tender Document preparation, Drawings and Tender Summary, Decisions to take, Arrange for Site Visit and Investigation, Consultation, Queries and Meetings, and Other Associated Works, Construction Schedule and Other Related Schedules, Collect Information, Determination of Bid Price, Analysis of Rates, Fix Mark-up, Computing Bid Price, Submit Bid, Post-Submission Activities.

Text Books

1. Construction Project Scheduling, Michael T.callahan, Daniel quackenbush james E. Rowings-Mcgraw-Hill series in construction engineering and project management.
2. Construction Project Management-Theory and Practice, Kumar Neeraj Jha .
3. Project Planning and control with PERT & CPM, B.C.Punmia & K.K.Khandelwal: Laxmi Publications.
4. Construction economics: A new approach, Danny Myers, Taylor and Francis publisher.

Reference Books

1. The Construction industry aspects of its economics and management, Ofori. G.Singapore University press.
2. Estimating and Costing, B.N.Dutta,UBS Publishers, 2000.
3. Construction Management & Planning, B.Sengupta & H.Guha; TataMcGraw-Hill Publishing Co.Ltd. New Delhi.

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Optional Elective - VII

OPTIMIZATION TECHNIQUES

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with various methods of optimization, decision making methods and design of civil engineering systems structural members.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- formulate objective functions and constraints
- understand intricacies of classical and non-traditional optimization methods
- understand applicability of optimization methods to civil engineering problems

Course Content

UNIT - I: Introduction

Basic theory and elements of optimization Terminology and definitions Basic principles and procedure of optimization. Classical Methods of Optimization: Trial and error method, Monte Carlo method and Lagrangian Multiplier Method.

Linear Programming: Introduction, terminology, standard form of linear programming problem, geometrical interpretation, canonical form of equation graphical and algebraic methods of solving L.P. problems,

UNIT - II: Linear Programming

Simplex, methods, Dual formulations.Network analysis: Introduction to network theory, transportation and assignment models formulation of mathematical models and solutions

UNIT - III: Non Linear programming

Non Linear programming: Unconstrained and constrained methods of optimization on .Univariate search, Steepest Descent Methods, Kuhn Tucker conditions – Penalty functions, slack variables and Lagrangian Multiplier methods

UNIT - IV: Dynamic Programming

Dynamic Programming, Necessity of non-traditional optimization methods, Differential Evolution and Particle Swarm Optimization Methods.

UNIT - V: Role of Multiobjective Optimization

Role of Multiobjective Optimization, Multicriterion criterion Decision Making Methods Compromise Programming, Analytical Hierarchy Process, TOPSIS

UNIT - VI: Structural Optimization

Optimum structural design of reinforced concrete T and L beams Optimization of planner trusses, Optimization of reinforced concrete beams, Optimization of concrete mix proportioning,Optimization of reservoir operation, Optimization of Pavement systems

Text Books

1. Engineering Optimization, S.S. Rao, New Age Internationals (1999)
2. Multicriterion Analysis in Engineering and Management, K.Srinivasa Raju, D. Nagesh Kumar, Prentice Hall of India (PHI) Learning Pvt. Ltd, New Delhi, 2014
3. Vedula, S. and Mujumdar, P. P., (2005) Water Resources Systems: Modeling Techniques and Analysis, Originally Published by Tata-McGraw Hill

Reference Books

1. Introduction to Optimum Design, 2nd Edition,McGraw-Hill Book Company, 2000.
2. Morrls A.J., "Foundations of Structural Optimization - A UnifiedApproach", 3rd Edition, John Wiley and Sons, 2003.

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Optional Elective - VII

ENTREPRENEURSHIP

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand entrepreneurial process and its significance in economic development of a nation.
- To provide awareness about entrepreneurship.
- To develop idea generation, creative and innovative skills.
- To design business plan.

Course Outcomes

Upon successful completion of the course, the students will be able to

- Analyse the business environment andidentify business opportunities.
- Identify the elements of success of entrepreneurial ventures.
- Statutory legal and financial regulations to start a business.
- Evaluate effectiveness of different entrepreneurial strategies.
- Specify performance indicators of entrepreneurship.

Course Content

UNIT - I: Introduction to Entrepreneurship

Entrepreneur – Characteristics and qualities, Entrepreneurs vs. Intrapreneurs and Managers – Classification of Entrepreneurs; Problems and challenges - Entrepreneurship in Economic Growth, Factors influencing Entrepreneurship. Opportunities for Entrepreneurs in India and Abroad.

UNIT - II: Micro, Small and Medium Enterprises

Small Enterprises – Definition, Classification – Characteristics, – Project Formulation – Steps involved in setting up of a Small Business – Identifying, Selecting a Business.Forms of Business; Women Entrepreneurship; Rural Entrepreneurship.

UNIT - III: Idea Generation and Feasibility Analysis

Sources of Ideas - Methods of idea generation - - Product Identification - Opportunity Selection - What is a Business Plan - Significance - Formulation of

Business Plan - Business Opportunities in Various Sectors - Errors in Business Plan Formulation – Preparation of Project Report.

UNIT - IV: Institutional support for Entrepreneurship

Role of Central and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants. District Industries Centres (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship and Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB).

UNIT - V: Financial Closure for Start-ups

Need – Sources of Finance,Banking sources; Non banking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise.

UNIT - VI: Support to Entrepreneurs

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting. Sick Industries Companies Act, 1985.

Text Books

1. Entrepreneurial Development, S.S.Khanka, S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Entreprenuership – Theory, Process and Practice, Donald F Kuratko, 9th edition, Cengage Learning 2014.
3. The Dynamics of Entrepreneurial Development and Management, Vasanth Desai, Himalaya Publishing House, 2011.

Reference Books

1. Entrepreneurship, Hisrich Robert D, Peters M P, 8th Edition, Tata McGraw-Hill, 2013.
2. Entrepreneurship, Rajeev Roy, 2nd edition, Oxford University Press, 2011.

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Professional Elective - V

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with basics of structural dynamics and earthquake engineering.
- To impart the knowledge of analyzing and designing earthquake resistant structure
- To introduce the seismic planning concepts and design principles of shear wall

Learning Outcomes

Upon successful completion of the course, the students will be able to.

- understand the basics of earthquake engineering
- apply the basic concepts of structural dynamics
- analyze and design earthquake resistant structure
- summarize the ductility considerations while designing a structure
- illustrate the seismic planning configurations
- design shear wall and analyze masonry buildings

Course Content

UNIT - I: Engineering Seismology

Seismology –Earthquake Terminology – Causes and effects of earthquakes – Elastic rebound and plate tectonics theories – Classification of earthquakes – Seismic waves – Earthquake size-Magnitude and Intensity – Seismic zones-Seismic zoning map of India.

UNIT - II: Introduction to Structural Dynamics

Theory of vibrations – Single Degree of Freedom (SDOF) Systems – Formulation of equations of motion – Multi-degree of freedom (MDOF) systems: Formulation of equations of motion – Orthogonal properties of normal modes

UNIT - III: Earthquake Analysis

Introduction –Earthquake response analysis of single and multi-storied buildings – Use of seismic coefficient and response spectrum method.

UNIT - IV: Codal Provisions of Ductile Detailing

Ductility considerations in earthquake resistant design of RCC buildings, Ductility factors as per IS13920 and IS: 4326 provisions – Beam, column and joints

UNIT - V: Seismic Planning & Design of Shear Walls

Plan Configurations – Torsion Irregularities – Re-entrant corners – Non-parallel systems– Diaphragm Discontinuity – Vertical Discontinuities in load path – Irregularity in strength and stiffness – Mass Irregularities –Vertical Geometric Irregularity – Proximity of Adjacent Buildings.

shear walls: Types – Design of Shear walls as per IS:13920 – Detailing of reinforcements

UNIT - VI: Lateral Load Analysis of Masonry Buildings

Introduction- Lateral load analysis of Masonry buildings- determination and distribution of lateral forces-determination of rigidity of shear wall-shear and forces due to torsion - increase in axial load.

Text Books

1. Earthquake Resistant Design of Structures, Pankaj Agarwal & Manish Shrikhande, 1st Edition, Prentice Hall of India, New Delhi
2. Earthquake Resistant Design of Structures, S. K. Duggal, 2nd Edition, Oxford University press.

Reference Books

1. Dynamics of Structures, Clough &Penzien, Second Edition, International Edition-McGraw Hill.
2. Dynamics of Structures, A. K. Chopra 4th Edition Pearson Education, Indian Branch, Delhi
3. Earthquake Tips, C.V.R. Murty- I.I.T. Kanpur.
4. Relevant Indian Standard codes: IS-875, IS-1893, IS-4326, IS-13920.

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Professional Elective - V

LOGISTICS INFRASTRUCTURE ENGINEERING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with various components, their functions and design principles of geometry in a railway track.
- To introduce the design principles of airport geometrics and pavements.
- To impart the knowledge of planning, construction and maintenance of Docks and Harbours.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the various components of a railway track
- design geometrics in a railway track.
- enumerate the need of turnouts and controllers in transportation network
- choose the area required for the construction of airports as per ICAO and FAA specifications
- design airfield pavements and suggest the methods to eliminate the pavement failures.
- explain the different elements in Docks and Harbours.

Course Content

A) Railway Engineering

UNIT - I: Components of Railway Engineering

Permanent way components – Railway Track Gauge - Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast – Rail Fastenings – Creep of Rails - Theories related to creep – Adzing of Sleepers - Sleeper density – Rail joints.

UNIT - II: Geometric Design of Railway Track

Alignment – Engineering Surveys - Gradients- Grade Compensation- Cant and Negative Super elevation- Cant Deficiency – Degree of Curve – safe speed on curves – Transition curve – Compound curves – Reverse curves – Extra clearance on curves – widening of gauge on curves – vertical curves – cheek rails on curves.

UNIT - III: Turnouts & Controllers

Track layouts – Switches – Design of Tongue Rails – Crossings – Turnouts – Layout of Turnout – Double Turnout – Diamond crossing – Scissors crossing.

Signal Objectives – Classification – Fixed signals – Stop signals – Signalling systems – Mechanical signalling system – Electrical signalling system – System for Controlling Train Movement – Interlocking – Modern signalling Installations.

B) Airport Engineering

UNIT - IV: Airport Planning & Design

Airport Master plan – Airport site selection – Air craft characteristics – Zoning laws – Airport classification – Runway orientation – Wind rose diagram – Runway length – Taxiway design – Terminal area and Airport layout – Visual aids and Air traffic control.

UNIT - V: Runway Design

Various Design factors – Design methods for Flexible pavements – Design methods for Rigid pavements – LCN system of Pavement Design – Airfield Pavement Failures – Maintenance and Rehabilitation of Airfield pavements.

C) Docks & Harbours

UNIT - VI: Planning, Layout, Construction & Maintenance of Docks & Harbours

Classification of ports – Requirement of a good port – classification of Harbours – Docks - Dry & wet docks – Transition sheds and workhouses – Layouts; Quays – construction of Quay walls – Wharves – Jetties – Tides - Tidal data and Analysis – Break waters – Dredging – Maintenance of Ports and Harbours – Navigational aids.

Text books

1. Railway Engineering, Saxena & S. P. Arora, Revised edition 2013 or 2010 , Dhanpat Rai, New Delhi
2. Airport Engineering, S. K. Khanna, M. G Arora & S. S. Jain, 6th edition 2012, Nemchand Bros, New Delhi.
3. Docks and Harbour Engineering, Bindra S.P, edition 2012, Dhanpathi Rai & Sons, New Delhi

Reference Books

1. Railway Engineering, Satish Chandra and Agarwal M.M., publication 2013, Oxford University Press, New Delhi
2. Transportation Engineering Planning Design, Wright P.H. &Ashfort N.J, 4th edition, John Wiley & Sons.
3. Airport Engineering, Virendra Kumar, Edition 1,Galgotia Publishers P.Ltd, New Delhi.
4. Transportation Engineering, Srinivasa Kumar R, publication 2014, University Press, Hyderabad
5. Highway, Railway, Airport and Harbour Engineering, Subramanian KP, publication in 2010, Scitech Publications (India) Pvt. Limited, Chennai.

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Professional Elective - V

FINITE ELEMENT METHODS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the fundamentals of finite element method.
- To impart knowledge of solving one dimensional and two dimensional problems by FEM.
- To introduce the concepts of axi-symmetric and iso-parametric formulation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- summarize the fundamentals of finite element method.
- develop the shape functions and stiffness matrices for various elements.
- solve the problems of one dimensional and two dimensional by FEM.
- apply the concepts of axi-symmetric and iso-parametric formulation for solving problems.
- evaluate higher order element problems by numerical techniques.

Course Content

UNIT - I: Introduction to FEM

Introduction, Need of FEM, FEM Vs Classical Methods, Advantages & Disadvantages, Applications of FEM, Functional Approximation Methods - Rayleigh – Ritz Method -Weight Residual Techniques, Steps involved in FEM as applicable to structural problems.

UNIT - II: One Dimensional Problems

Finite element modelling, Co-ordinates & shape functions, one dimensional scalar variable problems, Application to structural problems, Element stiffness of bar element due to axial loading, Formulation of stiffness matrix of bar element by direct stiffness method, minimum potential energy principle, Temperature effects.

UNIT - III: Analysis of Beams &Trusses

Derivation of stiffness matrix for beams by strain energy concept & direct stiffness method - problems on these concepts,Moment-curvature relation,Derivation of Stiffness matrix for trusses, stress calculations and problems on these concepts

UNIT - IV: Two Dimensional Problems

Finite element modelling of 2-D elements, Derivation of shape functions for two dimensional linear element(Triangular) by area co-ordinates, problems on these concept. Stress strain relationship matrix formulation for 3D & 2D systems, and stiffness matrix for CST element, Problems on these concepts.

UNIT - V: Axi-Symmetric Problems

Introduction, Axi-symmetric formulation, Derivation of shape function for axisymmetric triangular element, stress –strain relationship matrix, Strain & Stress displacement matrices- Stiffness matrix for Axi-symmetric triangular element & Problems on these concepts.

UNIT - VI: Iso-Parametric Elements & Numerical Integration

Introduction, Iso-parametric formulation, Higher order elements, Derivation of shape functions for a four noded quadrilateral element using natural coordinates, strain displacement matrix, stress-strain relationship matrix, stiffness matrix for Iso-parametric element, Numerical Integration, Gauss quadrature for performing numerical integrations.

Text Books

1. Finite Elements Methods in Engineering by TirupatiR.Chandrapatla and Ashok D.Belgaundu, 4th Revised Edition, 2012, Pearson Higher Education
2. Finite Element Analysis by Sk.Md ,Jalaludin , 2012, Anuradha Publishers

Reference Books

1. FEA–Theory & Programming by C.S.Krishna Murthy- Tata Mcgraw Hill, New Delhi.
2. FEA by S.S. Bhavakatti-New age international publishers FEA by David V Hutton,TataMcgraw Hill, New Delhi.

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Professional Elective - V

DESIGN AND DRAWING OF IRRIGATION STRUCTURES

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart the knowledge and principles of hydraulic structures.
- To impart the knowledge on design principles of irrigation structures.
- To enhance partical design concept.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- illustrate the components of surplus weir.
- analyze various elements of tank sluice with tower head.
- design the components of canal drop-notch type.
- design the canal regulator and its components,
- design and draw Syphon Aqueduct type-III,

Course Content

Design and Drawing of

1. Surplus weir
2. Tank sluice with tower head
3. Canal drop-Notch type
4. Canal regulator
5. Syphon Aqueduct type - III

Semester End Examination Pattern:

Any two questions of the above five questions maybe asked out of which the candidate has to answer one question

Text Books

1. Water Resources Engineering Principles and Practice, C.Styanarayana Murthy, New Age International Publishers.

Reference Books

1. Irrigation and Water Power Engineering, Punmia & Lal, Laxmi publications Pvt. Ltd., New Delhi.
2. Irrigation engineering and hydraulic structures, Sk.Garg, standard book house.

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Professional Elective - VI

PRE-ENGINEERED BUILDINGS

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart the concepts of designing water tanks, bridges, transmission line towers and chimneys.
- To familiarize on plastic behavior, plastic moment and plastic mechanism of steel structures like simple beams and portal frames.

Learning Outcomes

Upon successful completion of the course, the Students will be able to

- adopt principles of plastic analysis, plastic mechanism and apply to simple beams & frames.
- apply the design principles to gantry girderand elevated steel water tanks.
- identify the configuration of truss bridges and understand the design principles of truss elements.
- develop the methodology of designing transmission line tower structures.
- understand the design concepts of self-supporting chimneys & foundations.

Course Content

UNIT - I: Plastic Analysis

Plastic analysis of steel structures – Plastic bending in beams, collapse mechanism – Fully plastic Moment – Shape factor and Plastic moment – Ultimate load carrying capacity of simple beams and portal frames.

UNIT - II: Gantry girder

Introduction –loads-Fatigue effects- Specifications-Design procedure.

UNIT - III: Pre-engineered buildings

Introduction.Steel building systems: Origin- types -advantages and disadvantages. Prefabricated construction- necessity, advantage , disadvantages. Prefabricates classification-foundation- columns-beams-roof and floor panels, wall panels, box prefabricates, erection and assembly.

UNIT - IV: Bridges

Design of pedestrian Bridge (N-Truss), Design of through type truss bridge members for dead load and equivalent live load including top, bottom bracings.

UNIT - V: Towers

Towers Loading, Analysis & Design of Transmission line towers – simple problems

UNIT - VI: Chimneys

Design of self-supporting steel chimneys including foundation.

Note: Designs are by limit state method as per IS 800-2007.

Text Books

1. Design of Steel Structures Vol. I & II,Ramchandra,3rd Edition.
2. Design of Steel Structures, A.S.Arya & J.L.Ajmani, Nem chand & Brothers, Roorkee.

Reference Books

1. Comprehensive Design of steel structures, B.C.Punmia, Ashok kumar jain& Arun kumar jain, Laxmi publications, New Delhi.
2. Design of Steel Structures, S.K.Duggal Tata Mc Graw Hill, New Delhi.
3. Design of Steel Structures, P.Dayaratnam, Wheeler publishing, New Delhi.
4. Steel Structures, V.N.Vazirani & M.M.Ratwani, Khanna publications, New Delhi.
5. Plant cast, Precast and Prestressed Concrete ,Phillips, W.R. and Sheppard, D.A. (1980), , McGraw Hill, New York.
6. Relevant steel codes of Bureau of Indian standard.

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Professional Elective - VI

URBAN TRANSPORTATION PLANNING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the various procedures for travel demand estimation.
- To impart the knowledge on various data collection techniques for origin and destination data.
- To familiarize with various models and techniques for trip generation, trip distribution, mode choice and traffic assignment.
- To introduce alternative urban transport network plans.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- estimate travel demand for an urban area.
- plan the transportation network for a city.
- identify the corridor and plan for providing good transportation facilities.
- evaluate various alternative transportation proposals.

Course Content

UNIT - I: Urban Transportation Characteristics and Issues

Urban Transportation Problems & Travel Demand: Urban Issues, Travel Characteristics, characteristics of transportation system, Evolution of Planning Process, Travel Attributes, Assumptions in Demand Estimation, factors influencing travel demand

UNIT - II: Transport Planning Process

Data Collection And Inventories: Collection of data – Organisation ofsurveys and Analysis, Study Area, Zoning, Types and Sources of Data, RoadSide Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Use of Secondary Sources, Economic data – Income – Population – Employment –Vehicle Owner Ship.

UNIT - III: Trip Generation Analysis

Trip Generation:UTPS Approach, Trip Generation Analysis:Zonal Models, Category Analysis, Household Models, Trip Attraction models,Commercial Trip Rates;

UNIT - IV: Trip Distribution Analysis

Trip Distribution: Growth Factor Methods, average factor method, furness method, GravityModels, calibration of gravity model, disadvantages of growth factor method

UNIT - V: Mode Choice Analysis

Mode Choice Behaviour, Competing Modes, ModeSplit Curves, Aggregate and Disaggregate Approaches; Discrete ChoiceAnalysis, Choice sets, Maximum Utility, Probabilistic Models: Binary Logit,Multinomial Logit Model – IIA property; Aggregation

UNIT - VI: Traffic Assignment

Route Properties, Path Building Criteria, Skimming Tree,All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation ofAssigned Volumes, Equilibrium Assignment.

Text Books

1. Introduction to Urban System Planning by Hutchinson, B.G., 1st edition (1974), McGraw Hill.
2. Transportation Engineering - An Introduction by Khisty C.J., 3rd Edition, Prentice Hall.

Reference Books

1. Urban Transportation Planning: A decision oriented Approach by Mayer M and Miller E, 2nd Edition, McGraw Hill.
2. Fundamentals of Transportation Planning by Papacostas, 3rd Edition, Tata Mc Graw Hill.
3. Traffic Engineering and Transportation Planning by Kadiyali.L.R, 6th Edition, Khanna Publishers, New Delhi.

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Professional Elective - VI

SOIL DYNAMICS AND MACHINE FOUNDATIONS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on free and forced vibrations with and without damping for single degree freedom system.
- To familiarize field and laboratory methods of determination Dynamic Soil Properties.
- To introduce the designconsiderations of foundations for reciprocating machine, impact type and rotary type.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze free and forced vibrations with and without damping for single degree freedom system.
- solve one dimensional wave motion using wave propagation theory.
- understand pressure bulb concept by Pauw's Analogy.
- evaluate dynamic soil properties by field and laboratory tests.
- analyze machine foundations.

Course Content

UNIT - I: Introduction

Theory of vibrations: Basic definitions- free and forced vibrations with and without damping for single degree freedom system- Resonance and its effect – magnification – Logarithmic decrement.

UNIT- II: Soil Dynamics

Natural frequency of foundation – Soil system: Barkan's and IS methods – pressure bulb concept – Pauw's Analogy.

UNIT - III: Wave propagation

One dimensional wave motion – propagation in an elastic infinite medium – wave propagation in an elastic half space – propagation of flexural waves in beams on elastic foundations

UNIT - IV: Dynamic Soil Properties

Field and Laboratory methods of determination – Uphole, Down hole and cross hole methods –Cyclic plate load test – Block vibration test – Determination of Damping factor

UNIT - V: Block foundation

Degrees of freedom - analysis under different modes of vibration – codal provisions for design and construction of foundations for reciprocating machine, impact type and rotary type.

UNIT - VI: Vibration Isolation

Generation and propagation of vibrations – basic concept of vibration isolation – base isolation – shock isolation – seismic isolation of bridges

Text Books

1. Handbook of Machine Foundations, P.Srinivasulu and G.V.Vaidyanathan, 1st edition, Tata McGraw Hill
2. Soil Dynamics, ShamsherPrakash, 1981 edition, McGraw Hill Publishers.
3. Soil Dynamics and machine foundations, Swami Saran, 1999 edition, Galgotia Publications Pvt Ltd.

Reference Books

1. Dynamics of Bases and Foundations, Barken, McGraw Hill Publishing Co.,New York.
2. Vibration of Soils and Foundations, Richart, Hall and Woods, Prentice Hall, eaglewood Cliffs, New Jersy, USA.

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Professional Elective - VI

ENVIRONMENTAL IMPACT ASSESSMENT

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with various methodologies of EIA for project assessment.
- To distinguish impact prediction, assessment based on significance and preparation of audit report.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the concept and importance of EIA
- delineate various methodologies available for assessment
- assess and predic the impacts related to soil and water.
- assess and predic the impacts related to air, noise, vegetation and wild life.
- prepare the outline of environmental audit.
- quote case studies of prominent developmental project.

Course Content

UNIT - I: Introduction

Salient Features of EIA, EIA Procedure, Scope of EIA, Classification And prediction of Impacts, Systematic Approach for Using EIA as a planning tool for major project Activities, Preparation of an EIA report

UNIT - II: EIA Methodologies

introduction, Criteria for the selection of EIA Methodology, EIA methods, Ad-hoc methods, matrix methods, Network method, Environmental Media Quality Index method, overlay methods, cost/ benefit Analysis, Predictive or Simulation Methods

UNIT - III: Soil and Water Assessment

Prediction and Assessment of Impacts on Soil and Ground Water Environment, Prediction and Assessment of Impacts on Surface Water Environment- (relevant case studies addressing the above impacts)

UNIT - IV: Prediction and Assessment of Impacts- Air, Noise, vegetation and wild life

Prediction and Assessment of Impacts on the Air Environment, Prediction and Assessment of Impacts of Noise on the Environment, Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation - (relevant case studies addressing assessment of impacts)

UNIT - V: Environmental Audit

Environmental Audit & Environmental legislation, objectives of Environmental Audit, Types of environmental Audit, stages of Environmental Audit, preparation of Audit report-(relevant case study addressing audit process)

UNIT - VI: Case Studies

Case studies of EIA of developmental projects, Guidelines for Preparations of TOR's for Life of Industrial Development Projects for Initial Environmental Examination.

Text Books

1. Y. Anjaneyulu, V. Manickam, "Environmental Impact Assessment Methodologies", 2nd edition, B.S. Publication.
2. Larry W. Canter, "Environmental Impact Assessment", 1st edition, McGraw-Hill (international edition).

Reference Books

1. David P. Lawrence, "Environmental Impact Assessment - Practical Solutions to Recurrent Problems", 1st Edition, Wiley-Interscience.
2. Judith Petts, "Handbook of Environmental Impact Assessment" Volume I and II, Conwell Science.

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Professional Elective - I

SWITCH GEAR AND PROTECTION

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the operation of various types of circuit breakers and Relays.
- To introduce the concepts on various protection schemes of Generator, Transformer, Transmission lines and Bus bars.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify suitable circuit breaker and relay for a particular application
- describe the operating principles of various types of relays.
- select an appropriate protection scheme for generator and transformer
- choose an appropriate protection scheme for transmission line and bus-bar.
- analyze various methods of neutral grounding.

Course Content

UNIT - I: Circuit Breakers

Circuit Breakers: Elementary principles of arc interruption, Restriking Voltage and Recovery voltages, Average and Max. RRRV, Current Chopping and Resistance Switching - CB ratings and Specifications. Description and Operation of Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

UNIT - II: Fundamentals of Relays

Principle of Operation and Construction of electromagnetic attraction and induction type relays. PSM, TSM. Relays Classification: Instantaneous, DMT and IDMT types. Application of relays: Over current/ Under voltage relays, Direction relays, Universal torque equation. Introduction to Static relays and Comparison with Electromagnetic Relays.

UNIT - III: Distance and Differential Relays

Distance relays: Impedance, Reactance and Mho relays, Characteristics of Distance Relays and Comparison. Three-zone distance relay protection using Impedance relays .Differential Relays and Percentage Differential Relays.

UNIT - IV: Generator & Transformer Protection

Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on percentage of Unprotected Winding.

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CTs Ratio, Buchholtz relay Protection

UNIT - V: Transmission line and Bus-Bar Protection

Protection of Lines : Over Current, and. Translay Relay. Protection of Bus bars - Differential protection, Earth fault protection. over voltage protection using Lightning arresters.

UNIT - VI: Neutral Grounding

Grounded and Ungrounded Neutral Systems.- Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance - Arcing Grounds and Grounding Practices.

Text Books

1. Electrical Power Systems – by C.L.Wadhwa, New Age international (P) Limited, Publishers, 3rd editon.
2. Power System Engineering by B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, Dhanpat Rai & Co.
3. Switchgear Protection And Power Systems by Sunil S. Rao, Khanna Publishers, 2008 edition.

Reference Books

1. Power System Protection and Switchgear by Badri Ram and D N VishwakarmaTata McGraw-Hill Education, 2011
2. Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.
3. Principles of Power Systems by V.K Mehta and Rohit Mehta S.Chand& Company Ltd.New Delhi 2004.

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Professional Elective - I

COMPUTER NETWORKS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the fundamental concepts of computer networking.
- To familiarize with networking concepts to work on various Protocols of ISO-OSI and TCP/IP.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- compare protocol models (OSI, TCP/IP) and select suitable protocol for network design.
- design a network by deciding relevant multiplexing and switching technique to improve performance of the network.
- apply flow control, error control techniques and protocols to verify the correctness of data in the communicated network.
- Specify and identify deficiencies in Mac sublayer protocols.
- apply routing and congestion control algorithms to deliver data packets across the networks.
- use communication protocols like TCP, UDP, DNS, HTTP, FTP across the Internet.

Course Content

UNIT - I: Introduction

Introduction-components of data communication, data flow, Network Topologies, Categories of Networks-LAN, MAN, WAN, ISO-OSI model, TCP/IP.

UNIT - II: Physical Layer

Multiplexing- frequency division multiplexing, synchronous time division multiplexing, statistical time division multiplexing, Introduction to switching - Circuit Switched networks, datagram networks, V circuit networks.

UNIT - III: Data Link Layer

Design issues, Framing, error control, error detection and correction, CRC, Checksum, Hamming Code. **Elementary Data Link Layer protocols-** simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. **Sliding**

window protocol- One bit, Go back N, Selective repeat, Data link layer in HDLC, PPP.

UNIT - IV: Medium Access Control Sub Layer

ALOHA, CSMA, CSMA/CD, IEEE Standards-standard Ethernet, wireless LAN, Bridges.

UNIT - V: Network Layer

Routing algorithms- shortest path routing, distance vector, link state routing, and hierarchical routing.

Congestion control algorithms-congestion control in virtual circuit subnets, datagram subnet, leaky bucket, token bucket. The network layer in the internet: IPV4, IPV6

UNIT - VI: Transport and Application Layers

Transport layer: Transmission control protocol (TCP)- services, segment header, connection establishment, termination, transmission policy, congestion control. User datagram protocol (UDP)- header formats.

Application layer: The Domain Name System (DNS), Electronic Mail-Architecture-SMTP, POP3, FTP, HTTP.

Text Books

1. Andrew S Tanenbaum, Computer networks, 4th edition, Pearson.
2. Behrouz A Forouzan, Data communications and networking, 5th edition, TMH.

Reference Books

1. S. Keshav, An Engineering Approach to Computer Networks, 2nd edition, Pearson Education.
2. W.A. Shay, Thomson, Understanding communications and Networks, 3rd edition, Cengage Learning.

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Professional Elective - I

PULSE AND INTEGRATED CIRCUITS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of linear wave shaping for various inputs.
- To familiarize with the functioning of various Linear ICs such as OP-AMP, Timer, Voltage Controlled Oscillator.
- To introduce the concepts of D/A & A/D Convertors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design different RC differentiator and integrator circuits.
- analyze the various multivibrator circuits.
- infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
- elucidate and design linear and non-linear applications using op-amps.
- describe the concepts of filters, Timers and VCO .
- apply the concepts of A/D and D/A convertors in various applications.

Course Content

UNIT - I: Linear Wave Shaping

Response of High pass and Low pass RC Circuits for sine, step, pulse and square wave inputs. High pass RC circuit as a differentiator, low pass RC circuit as an integrator.

UNIT - II: Multivibrators

The Stable states of a binary, fixed bias transistor binary, self biased transistor binary, commutating capacitors, monostable multivibrator, gate width and wave forms of a collector-coupled monostable multivibrator, astable collector-coupled multivibrator.

UNIT - III: Introduction to OP-AMP

The Operational Amplifier- Block Diagram, Schematic symbol, IC 741-Pin configuration, Equivalent circuit, ideal and practical Op-amp specifications, DC and AC characteristics, compensation techniques.

UNIT - IV: Applications of OP- AMP

Inverting and Non-inverting configurations, Summing amplifier, Difference amplifier, Integrator, Differentiator, Instrumentation amplifier, Schmitt trigger, triangular wave generator.

UNIT - V: Active Filters, IC 555 Timer and IC 566 VCO

1st order low-pass Butterworth filter, 1st order high-pass Butterworth filter, Band-Pass filters, Band Reject filters, All –Pass filter, Voltage controlled Oscillator, IC 555 Timer- Pin diagram, functional description, IC 566 VCO- Pin configuration, Block diagram.

UNIT - VI: D/A & A/D Convertors

Basic DAC techniques: Weighted Resistor DAC, R-2R Ladder DAC. Direct Type ADCs: The Parallel comparator type, successive approximation ADC, Indirect Type ADC: The Dual-Slope ADC, Specifications of ADC/DAC.

Text Books

1. Jacob Millman and Herbert Taub, “Pulse, Digital and Switching Waveforms”, TMH1st Edition. (Units-I to III).
2. OP-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1987.

Reference Books

1. Fundamentals of Pulse and Digital circuits, Ronald J.Tocci, PHI 3rd Edition.
2. Linear Integrated Circuits – D. Roy Chowdhury, New Age International (p) Ltd, 2nd Edition,2003.

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Professional Elective - I

DATA STRUCTURES

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart knowledge on linear and non-linear data structures.
- To familiarize with different sorting and searching techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the working process of sorting (bubble, insertion, selection and heap) and searching (linear and binary) methods using a programming language.
- design algorithms to create, search, insert, delete and traversal operations on linear and non-linear data structures.
- evaluate the arithmetic expressions using stacks.
- choose appropriate collision resolution techniques to resolve collisions.
- compare array and linked list representation of data structures.

Course Content

UNIT - I: Sorting and Searching

Introduction- Concept of data structures, overview of data structures.

Searching: Linear search, Binary search.

Sorting (Internal): Basic concepts, sorting by: insertion (insertion sort), selection (selection sort), exchange (bubble sort).

UNIT - II: Linked Lists

Linked Lists- Basic concepts and operations of single linked list, circular linked list and double linked list.

UNIT - III: Stacks and Queues

Stack: Introduction, representation using arrays and linked list, operations on stack, evaluation of arithmetic expression.

Queue: Introduction, representation using arrays and linked list, operations on queue, circular queue.

UNIT - IV: Trees

Binary Trees: Basic tree concepts, properties, representation of binary trees using arrays and linked list, binary tree traversals.

Binary Search Trees: Basic concepts, BST operations: search, insertion, deletion and traversals, creation of binary search tree from in-order and pre (post) order traversals.

UNIT - V: Heap Trees and Graphs

Heap Trees: Basic concepts, operations, application-heap sort.

Graphs- Basic concepts, representations of graphs, graph traversals-breadth first search and depth first search techniques.

UNIT - VI: Hashing

Hashing: Basic concepts, hashing functions (division method, multiplication method), collision resolution techniques- open hashing and closed hashing.

Text Books

1. Horowitz, Sahani, Anderson Freed, "Fundamentals of Data Structure in C", 2nd edition, University Press.
2. Richard F, Gilberg, Forouzan, "Data Structures", 2nd edition, Cengage.

Reference Books

1. G. A. V. Pai, "Data Structures and Algorithms", TMH.
2. Debasis Samanta, "Classic Data Structures", 2nd edition, PHI.

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Optional Elective - III

MECHATRONICS

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on design of complex engineering systems using sensors, actuators, controllers.
- To familiarize with the intelligent systems used in Mechatronics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the elements of Mechatronic Systems
- select suitable sensors, actuators and controllers to meet specific requirements
- draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristic and membership functions respectively.

Course Content

UNIT - I:

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach, advantages and disadvantages of Mechatronics systems.

UNIT - II:

Sensors and Transducers: Types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature, light sensors and micro sensors.

UNIT - III:

Review of fundamentals of electronics. Data conversion devices, signal processing devices, relays, contactors and timers. Microprocessors, microcontrollers and PLCs.

UNIT - IV:

Actuators: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems. Description of PID Controllers.

UNIT - V:

Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits.

Pneumatics: Production, distribution and conditioning of compressed air, system components and graphic representations.

Electro hydraulic, Electro pneumatic and hydro pneumatic servo systems.

UNIT - VI:

Fuzzy Set Theory: Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of membership function, Fuzzy extension principle, Fuzzy Systems: fuzzification and defuzzification and fuzzy controllers.

Text Books

1. Bolton. W, "Mechatronics", Addison Wesley, 4th Edition, New Delhi.
2. Dan Nesulescu, "Mechatronics", 3rd Edition, Pearson Education
3. Michael B. Histand and David G. Aliatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill

Reference Books

1. Devadas Shetty, Richard A Kolk, "Mechatronics System Design",
2. B.P. Singh (2002), "Advanced Microprocessor and Microcontrollers" New Age International Publisher.
3. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
4. H.J.Zimmermann, Fuzzy Set Theory and Its Applications, 2nd Ed., Kluwer Academic Publishers, 1996.
5. S.N. Sivanandam and S.N.Deepa, "Principles of Soft Computing" Second Edition, Wiley India Pvt.Ltd.

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Optional Elective - III

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of object oriented programming.
- To impart the knowledge on AWT components in creation of GUI.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply Object Oriented approach to design software.
- create user defined interfaces and packages for a given problem.
- develop code to handle exceptions.
- implement multi tasking with multi threading.
- develop Applets for web applications
- design and develop GUI programs using AWT components.

Course Content

UNIT - I: Fundamentals of OOP and Java

Need of OOP, Principles of OOP Languages, Procedural Languages vs. OOP, Java Virtual Machine, and Java Features.

Java Programming constructs: variables, primitive data types, identifiers, keywords, Literals, operators, arrays, type conversion and casting.

UNIT - II: Class Fundamentals and Inheritance

Class fundamentals, declaring objects, methods, constructors, this keyword, overloading methods and constructors, access control.

Inheritance- Basics, types, using super keyword, method overriding, dynamic method dispatch, abstract classes, using final with inheritance, object class.

UNIT - III: Interfaces and Packages

Interfaces: Defining an interface, implementing interfaces, nested interfaces, variables in interfaces and extending interfaces. Packages: Defining, creating and accessing a package.

UNIT - IV: Exception Handling and Multithreading

Exception Handling- exception-handling fundamentals, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, user-defined exceptions.

Multi Threading - Introduction to multitasking, thread life cycle, creating threads, synchronizing threads, thread groups.

UNIT - V: Applets and Event Handling

Applets- Concepts of Applets, differences between applets and applications, life cycle of an applet, creating applets.

Event Handling- Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter Classes.

UNIT - VI: AWT

The AWT class hierarchy, user interface components- label, button, checkbox, checkboxgroup, choice, list, textfield, scrollbar, layout managers –Flow, Border, Grid, Card, GridBag.

Text Books

1. Herbert Schildt, Java The complete reference, 7th edition, TMH.
2. Sachin Malhotra, Saurabh choudhary, Programming in JAVA, 2nd Eidtion, Oxford.

Reference Books

1. Joyce Farrel, Ankit R.Bhavsar, JAVA for Beginners, , 4th edition, Cengage Learning.
2. Y.Daniel Liang, Introduction to Java Programming, 7th edition, Pearson.
3. P.Radha Krishna, Object Oriented Programming Through Java, Universities Press.

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Optional Elective - III

CONTROL SYSTEM DESIGN

III Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with various design specifications.
- Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
- Design controllers using the state-space approach.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- improve the performance of control systems with the aid of controllers and compensators.
- design lag, lead and lag–lead compensators.
- employ p, pi, pd and pid controllers.
- employ the state–space representation for the analysis and design of state feedback systems.
- apply the fundamental principles of nonlinearities to a nonlinear system.

Course Content

UNIT - I: Introduction

Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

UNIT - II: Design of Classical Control System in the time domain

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

UNIT - III: Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

UNIT - IV: Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

UNIT - V: Control System Design in state space

state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer.

UNIT - VI: Nonlinearities and its effect on system performance

Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text Books

1. Automatic control system – B.C.Kuo , john wiley and son's 8th edition, 2003.
2. Control system engineering – Norman S-Nice, Willey Studio Edition, 4th Edition.
3. Linear control system analysis and design (conventional and modern) - J. J. D'Azzo and C. H. Houpis, McGraw Hill, 1995.

Reference Books

1. Design of feedback Control Systems - R. T. Stefani and G. H. Hostetter, Saunders College Pub, 1994.
2. Modern control engineering – K.Ogata , prentice Hall of India Pvt. Ltd., 5th Edition.
3. Feed back and control system – Joseph J Distefa
4. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International Limited Publishers, 2nd edition.

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Professional Elective - II

DIGITAL SIGNAL PROCESSING

III Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of discrete time signals and systems
- To introduce the concepts of Z-transform and frequency domain representation of discrete time signals.
- To familiarize with the designing of digital filters and their realization.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze and process signals in the discrete domain.
- determine the Fourier series coefficients and z-transform of discrete time signals.
- apply the various transform techniques on discrete time signals.
- design digital filters (IIR and FIR) for a given specifications.
- apply various windowing techniques in the design of FIR filter.
- realize digital filters (IIR and FIR).

Course Content

UNIT - I: Discrete Time Signals and Systems

Discrete time signals- Classification, Elementary discrete time signals, Basic operations on Sequences; Discrete time Systems-Classification, Discrete time Linear Time Invariant Systems and their Properties, Convolution Sum.

UNIT - II: Z-Transform and Discrete Fourier Series

Z Transform of sequence, Properties of ROC, Properties of Z transform, Inverse Z transform- partial fraction method.

Discrete Fourier Series: Fourier series for discrete time periodic signals, Fourier Transform for discrete time aperiodic signals, Energy Density Spectrum, Relationship of Fourier transform to Z transform, Frequency Response.

UNIT - III :Discrete Fourier Transform

Frequency Sampling- Discrete Fourier Transform (DFT), Properties of DFT, Linear Convolution of sequences using DFT, Relationship between DFT and Z transform.

UNIT - IV: Fast Fourier Transforms (FFT)

Fast Fourier Transform-Radix-2 decimation in time and in frequency FFT algorithms, IDFT using FFT algorithms.

UNIT - V: Design of IIR Filters

Analog filter approximation-Butterworth and Chebyshev (Type-I) filters, Design of IIR filters from analog filters- Impulse Invariant technique, Bilinear transformation

UNIT - VI :Design of FIR Filters

Linear Phase FIR filters-Frequency Response, Fourier Series Method of designing FIR filter, Design of FIR filters using Windows (Rectangular, Bartlett, Hamming, Hanning)

Realization of Digital Filters: Realization of IIR Filters- Direct form I, II; Realization of FIR Filters- Transversal Structure, Cascade Realization

Text Books

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G.Manolakis, Pearson Education / PHI, 2013.

Reference Books

1. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI
2. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006
3. Digital Signal Processing: MH Hayes, Schaum's Outline series, TATA Mc-Graw Hill, 2007.

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Professional Elective - II

EMBEDDED SYSTEM DESIGN

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objective

- To introduce the concepts of embedded system design and to show how such systems are developed using a concrete platform built around.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between the general computing system and the embedded system.
- differentiate general purpose processors and single purpose processors.
- Model different state machines and concurrent process.
- specify different design technologies of software and hardware design.

UNIT - I: Introduction

Embedded System-Definition, Classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware.

Design challenge-optimizing design metrics, processor technology, IC technology, Design Technology.

UNIT - II: Single Purpose Processors

RT-level combinational logic, sequential logic (RTlevel), custom single purpose processor design (RT-level), optimizing custom single purpose processors.

UNIT - III: General Purpose Processors

Basic architecture, operation, Pipelining, programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs) – Micro Controllers and Digital Signal Processors.

UNIT - IV: State Machine And Concurrent Process Models

Introduction, models Vs. languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM), concurrent process model.

UNIT - V:Interfacing

Communication Basics, Arbitration, Multilevel Bus Architectures, Advanced Communication Principles

UNIT - VI: Design Technology

Automation: Synthesis- Parallel evolution of compilation and synthesis, synthesis levels, Logic Synthesis, RT synthesis, Behavioral Synthesis, Systems Synthesis and Hardware/ Software Co-Design, Verification: Hardware/Software co-simulation.

Text Books

1. Frank Vahid, Tony D. Givargis, "Embedded System Design - A Unified Hardware/Software Introduction", John Wiley, 2002. (Unit II to VI).
2. Introduction to Embedded Systems - Shibu.K.V, Tata McGraw Hill Education Private Limited, 2009 (Unit I).

Reference Books

1. Raj kamal, "Embedded Systems", TMH, 2nd Edition, 2008.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier Publications, 2005.

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Professional Elective - II

PRINCIPLES OF VLSI DESIGN

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize the students with the MOSFET characteristics, CMOS processing, and VLSI circuits characterization, design, and testing.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- characterize the MOS devices
- explore CMOS process technology
- draw layouts
- apply design techniques and testing and verification principles for VLSI circuits

Course Content

UNIT- I: MOS Transistor Theory

Brief history, VLSI design flow, ideal I-V characteristics, C-V characteristics, non-ideal I-V effects, DC transfer characteristics, switch-level RC delay models.

UNIT - II: CMOS Processing Technology

CMOS technologies, layout design rules, CMOS process enhancements, technology related CAD issues.

UNIT - III: Circuit Characterization and Performance Estimation

Delay estimation, logical effort and transistor sizing, power dissipation, interconnect, reliability, scaling.

UNIT - IV: Design Methodology

Design methodology, design flows, CMOS physical design styles.

UNIT - V: Special-purpose Subsystems

Packaging, power distribution, I/O, Clock.

UNIT - VI: Testing and Verification

Tests categories, testers, test fixtures, test programs, logic verification principles, silicon debug principles, manufacturing test principles, design for testability, boundary scan.

Text Book

1. Neil H.E.Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education Inc., Third Edition, 2005 (Indian Reprint 2014).

Reference Books

1. Kamran Eshraghian, Douglas A Pucknell, and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems", PHI Learning, 2009.
2. Sung-Mo Kang, Yusuf Leblebici "CMOS Digital Integrated Circuits: Analysis and Design", TMH Education, Third Edition, 2003.
3. Carver Mead and Lynn Conway, "Introduction to VLSI Systems", Addison Wesley, First Edition, 1979.
4. Eugene D. Fabricius," Introduction to VLSI design", McGraw-Hill International Edition, 1990.
5. IIT Bombay," VLSI Design", NPTEL Web Course.

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DSP PROCESSORS AND ARCHITECTURE

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the Architecture and interfacing of TMS320C54XX processors.
- To conversant with applications of DSP processors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the concepts of Sampling, DFT and Filters.
- calculate DSP computational Errors.
- identify the Architectural features of DSP processors.
- interface I/O and memory devices with DSP Processors.

UNIT - I: Computational Accuracy in DSP Implementations

Number formats for signals and coefficients in DSP systems, dynamic range and precision, sources of error in DSP implementations, A/D Conversion errors, DSP computational errors, D/A conversion errors, compensating filter.

UNIT - II: Architectures for Programmable DSP Devices

Basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing.

UNIT - III: Programmable Digital Signal Processors – TMS320C54XX

Data addressing modes, memory space, program control, instructions and programming, on-chip peripherals, interrupts pipeline operation.

UNIT - IV: Analog Devices Family of DSP Devices

Analog devices family of DSP devices-ALU and MAC block diagram, shifter instruction, base architecture of ADSP 2100, ADSP-2181 high performance processor.

UNIT - V: Blackfin Processor

Introduction to Blackfin processor-The Blackfin Processor, introduction to micro signal architecture, overview of hardware processing units and register files, address arithmetic unit, control unit, bus architecture and memory, basic peripherals.

UNIT - VI: Applications of Programmable DSP Devices

Introduction, DSP- based biotelemetry receiver:, Pulse Position Modulation, decoding scheme for the PPM Receiver, biotelemetry receiver implementation, ECG signal processing for heart rate determination, brain tumor detection using DSP processor.

Text Books

1. Avtar Singh and S. Srinivasan –,"Digital Signal Processing" , Thomson Publications, 2004.
2. K Padmanabahan, R.Vijayarajeswaran, Ananthi. S, "A practical Approach to Digital Signal Processing", New Age International, 2006/2009

Reference Books

1. Woon-SengGan, Sen M. Kuo, "Embedded Signal Processing with the Micro signal Architecture", Wiley - IEEE Press, 2007.
2. B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", 2004, TMH.
3. Jonatham Stein, "Digital Signal Processing", John Wiley, 2005.

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DATABASE MANAGEMENT SYSTEMS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of database systems and different issues involved in the database design.
- To introduce concepts on writing SQL for storage, retrieval and manipulation of data in a relational database.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- recognize the importance of database system over file processing system.
- analyze an information storage problem and derive an information model in the form of an entity relationship diagram.
- write simple and complex queries using Structured Query Language (SQL) for storage, retrieval and manipulation of data in a relational database.
- employ principles of normalisation for designing a good relational database schema.
- describe the issues and techniques relating to concurrency and database recovery in a multi-user database environment.

Course Content

UNIT - I: Introduction to Database

Introduction, Advantages of using DBMS, Data Models, Levels of Abstraction, Entity- Relationship Model: Attributes and Keys, Relationship Types, Weak Entity set, Strong Entity Set, Enhanced E–R Modeling: Specialization and Generalization, Database design for Banking Enterprise, Reduction to relational schemas.

UNIT - II: Relational Model and SQL

Relational Model: Basic Concepts, Schema and Instances, Keys, Relational Algebra, SQL: DDL, DML, Integrity constraints, Defining different constraints on a table, Set operations, Aggregate Functions, Group by and Having clauses, Nested queries.

UNIT - III: Database Design

Functional dependencies: Partial, full, transitive and trivial dependencies, Axioms, Decomposition: Lossless Join and Dependency Preserving decomposition, Attribute Closure, Normal forms: 1NF, 2NF, 3NF and BCNF.

UNIT - IV: Transaction Management

Transaction concept, ACID properties, Transaction State Diagram, Schedules-Serial, Concurrent and Serializable Schedules, Serializability- Conflict and View serializability, Recoverability.

UNIT - V: Concurrency Control

Concurrency Control- Concurrent Execution of Transactions, Anomalies due to Concurrent Execution, Lock-based protocols-2PL, Strict 2PL and Rigorous 2PL, Timestamp-based protocols, Thomas Write Rule, Deadlock Handling-Deadlock Prevention, Deadlock detection and recovery.

UNIT - VI: Crash Recovery

Crash Recovery - Failure classification, Different types of Recovery techniques: deferred update, immediate update, Shadow paging, Checkpoints.

Text Books

1. Korth and Sudarshan, Database System Concept, 3rd edition, MH.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, MH.

Reference Books

1. Elmasri Navrate, Fundamentals of Database Systems, 5th Pearson Education
2. C.J.Date, Introduction to Database Systems, 8th Pearson Education
3. Peter Rob and C Coronel, Database Systems design, Implementation, and Management, 7th Edition.

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Optional Elective - V

NANO ELECTRONICS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand the limitations of scaling the silicon devices, basic concepts and progress of nanoelectronics.
- To know the fabrication techniques and scaling of nanodevices.
- To study the significance of tunneling effect in nanoelectronic devices and the concepts of Coulomb blockade.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the behavior of nanoscale devices.
- explore the fabrication techniques used for nanodevices.
- identify the importance of scaling.
- demonstrate the concepts of coulomb blockade and electron transport mechanisms.

Course Content

UNIT - I: Toward the Nanoscale

Scientific opportunities, technological motivations, improving materials on the nanoscale, fabrication techniques on the nanoscale, improvement in characterization methods for the nanoscale, new principles of device operation at the nanoscale, nanotechnology for optoelectronics.

UNIT - II: Growth and Fabrication of Nanostructures

Bulk crystal and heterostructure growth, nanolithography, etching, and other means of nanostructures and nanodevices, spontaneous formation and ordering of nanostructures, clusters and nanocrystals, methods of nanotube growth- chemical and biological methods for nanoscale fabrication, fabrication of nano-electromechanical systems.

UNIT - III: Nanoscale MOSFETs

Introduction, MOSFET scaling, short- channel effects, multiple-gate MOSFETs, FinFETs.

UNIT - IV: Tunnel Junctions

Tunneling through a potential barrier, potential energy profiles for material interfaces.

UNIT - V: Coulomb Blockade

Coulomb blockade in a nanocapacitor, tunnel junction excited by a current source, coulomb blockade in a quantum dot circuit.

UNIT - VI: Nanostructure Devices

Resonant tunneling diode, single electron transistors, carbon nanotube transistor, transport of spin and spintronics.

Text Books

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, and Michael A. Stroscio, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications", Cambridge University Press, 2008 (UNITS: I & II).
2. George W.Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009 (UNITS: IV - VI).

Reference Books

1. Anantha Chandrakasan, "FinFETs and Other Multi-Gate Transistors", Springer, 2008 (UNIT: III).
2. Jerry G. Fossum and Vishal P. Trivedi, "Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs", Cambridge University Press, 1st Edition, 2013 (UNIT: III)
3. Prof. Navakanta Bhat, "Nanoelectronics: Devices and materials", NPTEL Video Course, IISc, Bangalore.
4. MIT Open Course Ware, "Introduction to Nanoelectronics".
5. https://ocw.mit.edu/courses/.../6-701-introduction-to-nanoelectronics-spring-2010.

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Optional Elective - V

SOLAR AND WIND ENERGY SYSTEMS

III Year – II Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts of Wind power generation systems and their control
- To familiarize with different Solar power generation and its grid interfacing

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the energy utilization and application of renewable energy systems
- realize the concepts of fixed speed and variable speed wind energy systems
- explain the generation of electricity using PV systems with applications
- suggest appropriate PV interfacing methodology to grid

Course Content

UNIT - I: Introduction

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilization – Renewable Energy Scenario in India and around the World Applications of renewable energy systems.

UNIT - II: Wind Turbines

Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects

UNIT - III: Constant Speed Wind Generation Systems

Generating Systems- Constant speed constant frequency systems - Choice of Generators- Synchronous Generator-Squirrel Cage Induction Generator.

UNIT - IV: Variable Speed Wind Generation Systems

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG

UNIT - V: PV Systems

Introduction to PV-Cells and their structures, Array, Solar power extraction using PV-Cells, I-V Characteristics, Maximum power point tracking-Methods, Applications

UNIT - VI: PV Interfacing Systems

PV Inverters without D.C. to D.C. converters, PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation. Grid interfacing-with isolation, without isolation

Text Books

1. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.

Reference Books

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.
2. L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990

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Professional Elective - III

BIG DATA ANALYTICS

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the architectural concepts of Hadoop and introducing map reduce paradigm.
- To disseminate the knowledge on how to summarize, query, and analyze data with Hive.
- To familiarize with business decisions and create competitive advantage with Big Data analytics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- summarize the importance of Big Data and its problems (storage and analysis)
- outline the building blocks of hadoop and anatomy of file read and write
- analyze data with hadoop MapReduce
- generalize how MapReduce works when running a job
- choose best programming tools for solving real world and industrial problems.

Course Content

UNIT - I: Introduction to Big Data

What is Big Data, Characteristics of Big Data - The Four V's, Why Big Data is important, data, data storage and analysis, comparison with other systems, brief history of Hadoop, Apache Hadoop and the Hadoop eco system.

UNIT - II: The Hadoop Distributed File System

The design of Hadoop Distributed File System (HDFS), Architecture, Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), Basic file system operations, anatomy of a File read, anatomy of a File write.

UNIT - III: Introduction to Map Reduce

A Weather Dataset, analyzing weather data with UNIX tools, analyzing data with Hadoop, Map and reduce, java map reduce, The old and new Java MapReduce APIs, data flow, combiner functions, running a distributed map reduce job.

UNIT - IV: How Map Reduce works

Anatomy of a MapReduce job run : job submission, job initialization, task assignment, task execution, progress and status updates, job completion; Shuffle and sort : the map side, the reduce side.

UNIT - V: Pig

Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

UNIT - VI: Hive

Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables with Hive, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data.

Text Books

1. Tom White, Hadoop: The Definitive Guide, 3rd Edition, O'Reilly.
2. Chuck Lam, Hadoop in Action, 1st MANNING Publ.
3. Dirk deRoos, Hadoop for Dummies, 1st edition, For Dummies.

Reference Books

1. Paul Zikopoulos, Tom Deutsch "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st Edition, TMH, 2012.
2. Srinath Perera, Thilina Gunarathne, Hadoop Map Reduce Cookbook, Packt Publishing.

Web Links

1. Hadoop:http://hadoop.apache.org/
2. Hive:https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html.

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Professional Elective - III

CMOS DIGITAL IC DESIGN

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize the students with the design of CMOS digital circuits.
- To make the students understand the impact of interconnects on the delay offered by digital logic circuits.

Course Outcomes

Upon successful completion of the course, the students will be able to

- characterize the behaviour of CMOS inverter
- design various combinational andsequential circuits using CMOS logic
- identify different components contributing to delay offered by interconnects
- design complex digital circuits
- design memory based array structures.

Course Content

UNIT - I: The CMOS Inverter

The static CMOS inverter, static behaviour, dynamic behaviour, power, energy and energy delay, technology scaling and its impact on the inverter metrics.

UNIT - II: Combinational Logic Design in CMOS

Static CMOS design, dynamic CMOS design, choosing a logic style, designing logic for reduced supply voltages.

UNIT - III: Sequential Logic Design in CMOS

Timing metrics for sequential circuits, classification of memory elements, static latches and registers, dynamic latches and registers, pipelining, non-bistable sequential circuits.

UNIT - IV: Interconnects

Capacitive parasitics, resistive parasitics, inductive parasitics

UNIT - V: Designing Complex Digital Integrated Circuits

Standard-cell design approach, array-based design, configurable and reconfigurable design.

UNIT - VI: Designing Memory Array Structures

Semiconductor memories, memory core, memory peripheral circuitry, design of PLA.

Text Book

1. Jan M. Rabaey, AnanthaChandrakasan, Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education Inc., Second Edition.

Reference Books

1. Sung-Mo Kang, Yusuf Leblebici "CMOS Digital Integrated Circuits: Analysis and Design", TMH Education, Third Edition, 2003.
2. David A. Hodges, Horace G. Jackson, Resve A Saleh, "Analysis and Design of Digital Integrated Circuits" McGraw-Hill Higher Education; 3 edition (2003)
3. Amitava Dasgupta, "Digital Integrated Circuits", NPTEL Video Course, Department of Electrical Engineering,IIT Madras.

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Professional Elective - III

POWER SEMICONDUCTOR DRIVES

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To envisage the use of single phase and Three - phase full controlled and half controlled rectifier to different motor drives.
- To familiarize the need of Electrical drive system with the chopper controlled Four-quadrant operation of DC motor and electric braking.
- To introduce the control operation of synchronous and asynchronous drives.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the operation of converter controlled electrical drives with active and passive loads
- realize the voltage and current waveforms of converter fed drives
- adopt the application of chopper for four quadrant operation of DC drives
- apply the scalar control and slip power control schemes to asynchronous motor drives
- describe the inverter-fed control of synchronous motor and its closed loop control methodologies

Course Content

UNIT - I: Control of DC Motors by Single Phase and Three Phase Converters

Introduction, Single Phase semiand fully controlled converter for separately excited DC motor drives and DC series excited motor- continuous and discontinuous conduction, Speed and Torque expressions and characteristics, numerical problems.

Three phase semi and fully controlled converters fed to DC separately excited and DC series motors (continuous current operation only) – Speed and Torque expressions and characteristics – numerical problems.

UNIT - II: Four Quadrant Operation of DC Drives

Introduction to Four quadrant operation –Dual converter for four quadrant operation, single phase and three phase dual converters, Electric Braking – Plugging, Dynamic and Regenerative Braking operations. Numerical problems

UNIT - III: Control of DC Motors by Choppers

Introduction, principle of chopper operation, control techniques used in DC choppers Chopper configuration,Single quadrant, two –quadrant and four quadrant chopper fed dc separately excited and series excited motors (Continuous current operation) and their Output voltage and current wave forms – Speed torque expressions. Numerical Problems, Closed Loop operation of Chopper controlled Dc excited motor- operation below and above base speed

UNIT - IV: Control of Induction Motor from Stator Side

i) Through stator voltage control: Introduction to Speed control methods of Induction motor from Stator side. Stator voltage control, Ac Voltage Controller for three phase induction motors, advantages and disadvantages, four quadrant AC voltage controller.

ii) Through Rotor Frequency: Variable frequency characteristics, voltage source inverter(VSI) fed Induction motor drive, Waveforms –speed torque characteristics, Variable voltage and frequency control of induction motor by Voltage source Inverter (PWMControl)– numerical problems on induction motor drives – Closed loop operation of induction motor drive with regenerative braking.

UNIT - V: Control of Induction Motor of Rotor Side

Static rotor resistance control – Slip power recovery Schemes – Static Scherbius drive – Static Kramer Drive – their performance and speed torque characteristics – advantages disadvantages, applications – Numerical Problems.

UNIT - VI: Control of Synchronous Motors

Types of control, Separate control &self-control of synchronous motors –VSI fed self-controlled synchronous motor drive, phasor diagrams of cylindrical rotor wound field motor and salient pole motor, synchronous operation from fixed frequency supply-starting torque, running torque, pull in and pullout torque, braking, speed control of synchronous motor drive-open loop true synchronous mode, self-control mode, LCI fed SM drive, Closed loop LCI fed SM drive.

Text Books

1. Fundamentals of Electric Drives – by G K Dubey Narosa Publications.
2. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI.

Reference Books

1. Power Electronics – MD Singh and K B Kanchandani, Tata – McGraw-Hill Publishing company,1998.
2. Modern Power Electronics and AC Drives by B.K.Bose, PHI.
3. Power semiconductor drives by S. Shivsnagaraju, M Balasubbareddy, A. Mallikarjun prasad, PHI publications, Eastern economy Edition, 2012.

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Professional Elective - III

FLEXIBLE AC TRANSMISSION SYSTEMS

IV Year – I Semester

Lecture	: 3	Tutorial	: 1	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Course Objectives

- To Introduce the Flexible AC Transmission System devices for understanding the power flow in transmission lines.
- To familiarize the students with the basic types of FACTS controllers.
- To develop an understanding of different types of converters and their operation in different modes.
- To expose students to the practical problems associated with the operation of Power system and the necessity of FACTS devices.
- To gain the knowledge of selection of appropriate FACTS device for a particular application.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the knowledge of FACTS devices for enhancing power handling capacity in the transmission network.
- demonstrate the knowledge and understanding of the fundamental principles and control practices associated with FACTS controllers.
- describe different types of FACTS controllers.
- determine the operational related problems of transmission system and suggest the remedial measures.
- select an appropriate FACTS controller to meet specified performance requirements.

UNIT - I: FACTS Concepts

FACTS concepts, Transmission interconnections, power flow in an AC System, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

UNIT - II: Voltage Source Converters

Single phase, three phases, full wave bridge converters, transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source converters, and comparison of current source converters with voltage source converters..

UNIT - III: Static Shunt Compensation

Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable var generation, variable impedance type static var generators, switching converter type var generators, hybrid var generators.

UNIT - IV: SVC and STATCOM

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

UNIT V: Static Series Compensators

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

UNIT - VI: Static Voltage and Phase Angle Regulators

Voltage and phase angle regulation, power flow control by phase angle regulators, real and reactive loop power flow control, improvement of transient stability and power oscillation damping with phase angle regulators, functional requirements, continuously controllable thyristor tap changers, thyristor tap changer with discrete level control, switching converter-based voltage and phase angle regulators, hybrid phase angle regulators

Text Books

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press, Indian Edition is available:—Standard Publications

Reference Books

1. HVDC & FACTS Controllers: applications of static converters in power systems - Vijay K.Sood- Springer publishers.
2. Sang.Y.H and John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).

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Professional Elective - IV

CYBER SECURITY

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To understand security concepts, Ethics in Network Security.
- To familiarize with new algorithms (mathematical formulas) and statistical measures that assesses relationships among members of large data sets.
- To identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks, and apply those to design and evaluate counter measure tools.
- To gain knowledge on security threats, and the security services and mechanisms to counter them.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline management framework
- describe various tools that can be used in cyber security management.
- write a secure access client for access to a server
- determine firewall requirements, and configure a firewall
- employ policies and standards to solve security problems
- use security techniques in an organisational context

Course Content

UNIT - I: Systems Vulnerability Scanning

Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet.

UNIT - II: Network Defence tools

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of

Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System.

UNIT - III: Web Application Tools

Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities -Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John theRipper,L0htcrack, Pwdump, HTC-Hydra.

UNIT - IV: Introduction to Cyber Crime and law

Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime.

UNIT - V: Introduction Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000 to Incident Response

UNIT - VI: Introduction to Cyber Crime Investigation

Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks

Text Books

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley.

Reference Books

1. Cyber Security essentials edited by James Graham, Ryan Olson, Rick Howard.
2. Introduction to Computer Networks and Cybersecurity By Chwan-Hwa (John) Wu, J. David Irwin.

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Professional Elective - IV

DIGITAL IMAGE PROCESSING

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce fundamental concepts of image processing and different operations on image elements.
- To expose to the practical problems associated with processing of an image.
- To familiarize with advanced image processing operations.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the need for image transforms, types and their properties.
- process the images for the enhancement of certain properties or for optimized use of the resources.
- explore causes for image degradation and to develop various restoration techniques.
- evaluate the image compression techniques

Course Content

UNIT - I: Fundamentals of Image Processing and Image Transforms

Introduction, fundamental steps in image processing, components of image processing system, image sensing and acquisition, image formation model, image sampling and quantization, pixel relationships, image distance measures.

Image Transforms - Need for image transforms, properties of DFT, Discrete Cosine Transform, Hadamard transform, Walsh transform, Haar transform, Slant transform.

UNIT - II: Image Enhancement

Spatial Domain: Gray level transformations, histogram processing, spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain – smoothing and sharpening filters, homomorphic Filtering, notch filter inverse filter, wiener filter.

UNIT - III: Image Restoration

Image degradation model, noise modeling, image restoration in the presence of only noise-mean filters, order statistic filters, band reject filters, band pass filters,

UNIT - IV: Image Segmentation and Morphology

Detection of discontinuities, edge detection, threshold based segmentation, region based segmentation – region growing, region splitting and merging.

Morphology: dilation, erosion, opening and closing, hit or miss transformation, basic morphological algorithms.

UNIT - V: Image Compression

Image compression: Fundamentals, image compression model, types of redundancy, variable length coding, arithmetic coding, LZW coding, bit-plane coding, run length coding.

UNIT - VI: Color Image Processing

Color Image Processing: Color fundamentals, color models-RGB,CMYK and HSI, color transformations.

Applications of image processing: Content based image retrieval systems, digital watermarking, image mosaicing and image compositing.

Text Books

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 2ndedition, Pearson Eduction, 2003.(Units: I-V except image transforms)
2. S.Sridhar, "Digital Image Processing",Oxford University Press,2011. (Unit-I image transforms and Unit-VI).

Reference Books

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India,2nd edition 2004.
2. S.Jayaraman, "Digital Image Processing", Tata McGraw-Hill Education, 2011.

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Professional Elective - IV

POWER SYSTEM OPERATION AND CONTROL

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize with the optimal generation allocation of power system with and without losses.
- To impart knowledge on the transmission loss formula and hydrothermal scheduling.
- To introduce the concepts of load frequency control and steady state response of single and two area systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- evaluate optimal generation schedule with and without losses.
- compute loss coefficients and transmission losses.
- find the solution for short term hydrothermal scheduling problems.
- determine the steady state changes in frequency in single area and two area load frequency control.
- suggest suitable voltage control method for different applications.

Course Content

UNIT - I: Economic Operation of Power System (without losses)

Optimal operation of Generators in Thermal Power Stations, heat rate Curve – Cost Curve, Incremental fuel cost, input output characteristics, Optimum generation allocation with line losses neglected.

UNIT - II: Economic Operation of Power Systems (with losses)

Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

UNIT - III: Hydrothermal Scheduling

Optimal scheduling of Hydrothermal System, scheduling problems – short term Hydrothermal scheduling problem.

UNIT - IV: Single Area Load Frequency Control

Necessity of keeping frequency constant, modeling of speed governing system, modeling of steam turbine, generator, Definition of Control area – Single area control – Block diagram representation of isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

UNIT - V: Load Frequency Controllers & Two Area Load Frequency Control

Proportional plus integral control of single area and its block diagram representation, steady state response – Load frequency control and economic dispatch control. Load frequency control of two area system – uncontrolled case and controlled case, tie-line bias control.

UNIT - VI: Reactive Power & Emergency Control

Relation between reactive power & voltage, different voltage control methods: Shunt & Series compensation, on-load tap changing transformer, booster transformer, Alternator voltage regulator (AVR), Emergency control: Concepts, Coherent area dynamics, stability enhancement methods, Average system frequency, center of Inertia.

Text Books

1. Electric Energy systems theory: Olle I.Elgerd TMH, 2^{nd} edition.
2. Power Systems Engineering : IJ Nagarath & DP Kothari – TMH.

Reference Books

1. Power System Analysis: Hadi Saadat - TMH.
2. Power System Analysis & Stability – S.S vadhera Khanna Publishers.
3. Power System Engineering, Chakravarthy, Soni, Gupta & Bhatnagar, Dhanapat Rai & Sons.

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Professional Elective - IV

HIGH VOLTAGE ENGINEERING

IV Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To understand breakdown mechanisms occur in solids gases and liquid dielectrics.
- To understand various generation methods employed for High DC, AC and impulse voltages.
- To distinguish various methods employed for measurement High DC, AC and impulse voltages.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyse the behavior of dielectric material under Different circumstances.
- demonstrate an understanding of high voltage engineering techniques.
- conduct analysis of industrial equipment.
- identify the most suitable equipment for performing specific testing on high voltage applications.
- perform basic AC, DC, impulse voltage and partial discharge tests on high voltage equipment and insulation systems in the laboratory environment.

UNIT - I: Break Down In Gaseous And Liquid Dielectrics

Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

UNIT - II: Generation Of High Voltages And Currents

Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators.

UNIT - III: Measurement Of High Voltages And Currents

Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

UNIT - IV: Non-Distructive Testing Of Material And Electrical Apparatus

Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements.

UNIT - V: High Voltage Testing Of Electrical Apparatus

Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, Radio Interference measurements

UNIT - VI: Industrial Application to High Voltage Engineering

Electrostatic precipitator, electrostatic separator, electrostatic copying, electrostatic coating and pulsed power.

Text Books

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition.
2. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition.

Reference Books

1. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
2. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.

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Optional Elective - VII

ANALOG AND DIGITAL COMMUNICATION

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize students with fundamentals of analog and digital communication systems and various techniques for analog and digital modulation and demodulation schemes.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the functioning of AM and FM transmitters and receivers.
- determine power relations for various modulation schemes and evaluate the impact of noise in AM and FM modulation schemes.
- explain basic concepts of Digital Communication System.
- analyse different digital modulation techniques.
- identify error detection & correction capabilities of linear block codes

Course Content

UNIT - I: Continuous Wave Modulation - I

Introduction, need for modulation, amplitude modulation-definition, description in time and frequency domains, power relations, generation and detection.

UNIT - II: Continuous Wave Modulation-II

DSB-SC- time-domain and frequency-domain description, generation and coherent detection, AM SSB Modulated waves-time-domain description. Noise in AM systems; Comparison of various AM techniques.

UNIT - III: FM Generation

Introduction to angle modulation, Single tone frequency modulation, narrow band FM and wideband FM time and frequency domain descriptions, constant average power, transmission bandwidth of FM wave, generation of FM waves: direct FM, Detection of FM waves: balanced frequency discriminator, pre-emphasis and de-emphasis in FM.

UNIT - IV: Digital Pulse Modulation

Elements of digital communication systems, Elements of PCM, Differential PCM systems (DPCM), Delta Modulation, Noise in PCM & DM Systems, Comparison of PCM & DM Systems.

UNIT - V: Digital Modulation Techniques

Gram-Schmidt orthogonality procedure, Modulation & demodulation: Phase Shift Keying , Differential Phase Shift Keying, Amplitude Shift Keying, Frequency Shift Keying, similarity of BFSK and BPSK

UNIT - VI: Information Theory & Coding

Information and its properties. Average information, Entropy and its properties. Shannon's theorem, Shanon-Fano and Huffman coding, efficiency calculations, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes.

Text Books

1. Simon Haykin, John Wiley, "Principles of Communication Systems", 2nd Edition.
2. H Taub & D. Schilling, Gautam Sahe, "Principles of Communication Systems",TMH, 2007 3rd Edition.

Reference Books

1. Singh & Sapre "Communication Systems Analog & Digital", TMH, 2004.
2. B.P. Lathi, "Communication Systems", BS Publication, 2006
3. John G. Proakis, Masond, Salehi, "Fundamentals of Communication Systems",PEA, 2006.

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Optional Elective - VII

INTRODUCTION TO PYTHON PROGRAMMING

IV Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the fundamentals of Python programming language.
- To familiarize with the various objects of Python.
- To learn exception handling in Python.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe the basic elements of Python.
- Implement branching constructs in Python.
- Describe the methodology of String Formatting.
- Differentiate between Tuples and Lists in Python.
- Define the properties of Dictionary keys.
- Implement various built-in methods of files in Python.

Course Content

UNIT - I

Introduction to python programming - python, history of python, features of python, downloading-installation and run the python script; python program input and output, comments, operators, variables and assignments.

UNIT - II

Syntax and style – statements and syntax, variable assignments, identifiers, basic style guidelines, memory management.

Data types – **Numbers**-introduction, types, sequences – **strings** –strings and operators.

UNIT - III

Lists- operators, built in functions, features of lists; **Tuples** - operators, built in functions, features of tuples; **Dictionaries**- introduction, operators, built in functions, dictionary keys.

UNIT - IV

Conditional and loop statements – if, else, else-if, while, for, break, continue, pass statements.

Functions- introduction, creating, calling and pass functions, function arguments.

UNIT - V

Files and input/output- objects, built-in functions, built-in attributes; **Modules**-introduction and importing modules.

Errors and exceptions – exceptions in python, detecting and handling exceptions

UNIT - VI

Classes and OOP – introduction, OOP, classes, instances, binding and method invocation, composition, sub classing and derivation, inheritance

Text Books

1. Wesley J. Chun, "Core Phython Programming", Prentice Hall, 2001.
2. Think Python, 2 nd ed, Allen Downey, 2012, Green Tea Press.

Reference Books

1. https://mva.microsoft.com/en-US/training-courses/introduction-to programming-with-python-8360?l=lqhuMxFz_8904984382
2. https://onlinecourses.nptel.ac.in/noc17_cs10/preview
3. https://www.tutorialspoint.com//python/index.htm

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Optional Elective - VII

INTEGRATION OF RENEWABLE ENERGY SOURCES

IV Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the characteristics of various types of renewable energy sources and converters.
- To explain the power quality issues on the grid by integrating renewable energy sources.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- Identify the characteristics of renewable energy sources and converters.
- To introduce the converter topologies
- Analyze the importance of storage and sizing of hybrid systems.
- Realize the problems related to isolated systems.
- Analyze the challenges faced by the grid by integrating renewable energy sources.
- Understand the power synchronizing technologies

Course Content

UNIT - I: Review of Characteristics of Power Sources

Basic review of power generation from wind - Solar PV - Thermal - Small hydro - Biomass power strategies in each of these energy conversion systems - Review of maximum power point tracking techniques in solar PV and wind (perturb & observe, hill climbs, incremental conductance).

UNIT - II: Converter Topologies

DC/DC converter (buck, boost, buck boost) - DC/AC inverters (sine, triangular, PWM techniques) - Phase locked loop for inverters.

UNIT - III: Hybrid Systems

Advantages of hybrid power systems - Importance of storage in hybrid power systems - Design of hybrid power system based on load curve - Sizing of hybrid power systems.

UNIT - IV: Isolated Systems

Control issues in isolated systems for voltage and frequency - Small signal stability in isolated power systems - Importance of storage and dump load in isolated systems.

UNIT - V: Issues in Integration of Renewable Energy Sources

Overview of challenges in integrating renewable sources to the grid - Impact of harmonics on power quality - Need to maintain voltage within a band and fluctuations in voltage because of renewable integration.

UNIT - VI: Power inverter and converter technologies

Mechanism to synchronize power from renewable sources to the grid - Overview of challenges faced in designing power injection from offshore generation sources - Challenges in modeling intermittent nature of renewable power in a power system.

Text Books

1. Power Electronics, Converters, Applications and Design" by N. Mohan; T.M. Undeland; W.P. Robbins. 1995, John Wiley and Sons.
2. Renewable Energy IntegrationChallenges and SolutionsSeries: Green Energy and TechnologyHossain, Jahangir, Mahmud, Apel (Eds.)

References Book

1. Integration of Alternative Sources of EnergyFelix A. Farret, M. Godoy Simões December 2005, Wiley-IEEE Press.

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Professional Elective - V

ELECTRICAL DISTRIBUTION SYSTEM

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce concepts on design of substation and primary feeders.
- To familiarize with various coordination procedures of protective devices.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish various load models in the distribution system
- describe the primary feeder ratings and voltage levels.
- design an optimum location of the substation.
- analyze the distribution system and its associated coordination procedures
- select appropriate voltage control method in the distribution systems

Course Content

UNIT - I: General Concepts

Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor loss factor – relationship between the load factor and loss factor. Classification of loads (residential, commercial, agricultural and Industrial) and their characteristics.

UNIT - II: Distribution Feeders

Design Considerations of Distribution Feeders; Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

UNIT - III: Substations

Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT - IV: System Analysis

Voltage drop and power – loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines. Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations DC distributors for following cases: radial DC distributor fed at one end and at both ends (equal / unequal voltages), ring main distributor, stepped distributor and AC distribution. Comparison of DC and AC distribution.

UNIT - V: Protection

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, and line sectionalizes, and circuit breakers.

Coordination: Coordination of Protective Devices: General coordination procedure, residual current circuit breaker RCCB (Wikipedia)

UNIT - VI: Compensation for Power Factor Improvement & Voltage Control

Capacitive compensation for power factor control, Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation- Economic justification- Procedure to determine the best capacitor location.

Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Text Book

1. "Electric Power Distribution System Engineering"- by Turan Gonen, Mc Graw-hill Book Company.

Reference Book

1. Electric Power Distribution- by A. S. Pabla, Tata Mc Graw – hill Publishing Company, 4th edition, 1997.

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Professional Elective - V

ARTIFICIAL INTELLIGENCE TECHNIQUES

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce concepts on Neural Networks and fuzzy logic
- To familiarize with the applications of AI techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe learning tasks in Artificial Intelligent Techniques(AIT).
- analyze learning algorithm for Neural Networks.
- analyze different architectures of Artificial Neural Networks.
- apply AIT to electrical engineering problems.

Course Content

UNIT - I: Introduction to AI techniques

Introduction to artificial intelligence systems– Humans and Computers – Knowledge representation – Learning process – Learning tasks – Methods of AI techniques.

UNIT - II: Neural Networks

Organization of the Brain – Biological Neuron – Biological and Artificial neuron Models, MC Culloch-pitts neuron model, Activation functions, Learning rules, neural network architectures- Single-layer feed-forward networks: – Perceptron, Learning algorithm for perceptron- limitations of Perceptron model

UNIT - III: ANN paradigm

Multi-layer feed-forward network (based on Back propagation algorithm)– Radial-basisn function networks- Recurrent networks (Hopfield networks).

UNIT - IV: Classical and Fuzzy Sets

Introduction to classical sets – properties – Operations and relations – Fuzzy sets – Membership – Uncertainty – Operations – Properties – Fuzzy relations – Cardinalities – Membership functions.

UNIT - V: Fuzzy Logic System Components

Fuzzification – Membership value assignment – Development of rule base and decision making system – Defuzzification to crisp sets – Defuzzification methods – Basic hybrid system.

UNIT - VI: Application of AI techniques

Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Reactive power control – Speed control of dc and ac motors.

Text Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran and G.A. Vijayalakshmi Pai – PHI Publication.
2. Fuzzy logic with fuzzy applications- by T.J. Ross, TMH.

Reference Books

1. Introduction to Artificial Neural Systems – Jacek M. Zurada, Jaico Publishing House, 1997.
2. Fundamentals of Neural Networks Architectures, Algorithms and Applications - by laurene Fausett, Pearson.
3. Neural Networks, Algorithms, Applications and programming Techniques by James A. Freeman, David M. Skapura.
4. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH.

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Professional Elective - V

ADVANCED CONTROL SYSTEMS

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To impart knowledge on the implementation of compensators in frequency domain.
- To impart knowledge on different types of state variable forms for the LTI and LTV systems.
- To familiarize with the concepts on nonlinear control systems.
- To introduce the concepts on design of state feedback controllers.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design a compensator for continuous time systems.
- apply the concepts of controllability and observability in evaluating the performance of control system.
- apply the fundamental principles of nonlinearities to a nonlinear system.
- determine the stability of a given nonlinear system.
- design an appropriate feedback controller and/or observer for physical plants.

Course Content

UNIT - I: Classical Control Design Techniques

Compensation techniques – lag, lead, lag-lead controllers design in frequency domain, PID controller tuning using Z-N method.

UNIT - II: Concept of Controllability and Observability

Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form. Tests for controllability and observability for continuous time systems –time invariant case, Principle of Duality, Controllability and observability form Jordan canonical form and other canonical forms.

UNIT - III: Describing Function Analysis

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.

UNIT - IV: Stability Analysis

Stability in the sense of Lyapunov's Lypanov's stability and Lypanov's instability theorems. Direct method of Lypunov's theorem for the Linear and Nonlinear continuous time autonomous systems.

UNIT - V: Model Control -I

Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement and ackermann's formula.

UNIT - VI: Model Control -II

State observers, Full order observer and reduced order observer, effects of the addition of the observer on a closed loop systems.

Text Books

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Modern control engineering – K.Ogata, prentice Hall Of India, 3rd edtion, 1998.
3. Control system Engineering – I.J. Nagarath, M.Gopal. New Age International Publications, 5th edition.

Reference Books

1. Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.
2. Systems and Control by Stainslaw H. Zak, Oxford Press, 2003.
3. Automatic feedback control system synthesis – Truxal, International student edition.

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Professional Elective - V

ENERGY, AUDIT, CONSERVATION AND MANAGEMENT

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the basic concepts of Energy Auditing and Management.
- To familiarize the various Techniques of Electrical Energy Conservation..

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the Process of Energy Audit of Industries.
- apply the concepts of Energy management for Efficient Energy Utilization and Conservation.
- identify a suitable method for Energy Conservation of various electric devices.
- analyze the benefits of energy conservation from the Economic aspects.

UNIT - I: Basic Principles of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT - II: Energy Management

Principles of energy management, organizing energy management program, initiating, planning,controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT - III: Energy Efficient Motors

Energy efficient motors , factors affecting efficiency, loss distribution , constructional details, characteristics - variable speed , variable duty cycle systems, RMS hpvoltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT - IV: Power Factor Improvement

Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on power factor, power factor motor controllers

UNIT - V: Lighting and Energy Instruments

Good lighting system design andpractice, lighting control ,lighting energy audit – Energy. Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

UNIT - VI: Economic Aspects and Analysis

Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment .

Text Books

1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998

Reference Books

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition,1995.
2. Energy management hand book by W.C.Turner, John wiley and sons.
3. Energy management and good lighting practice: fuel efficiency- booklet12-EEO.

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Professional Elective - VI

SOCIAL ELECTRICAL MACHINES

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objective

- To envisage the operation, characteristics and performance of descendants of synchronous and asynchronous motors.
- To familiarize with the open loop and closed loop operation and applications of special synchronous motors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe the operation of special synchronous motors.
- realize the performance of various special synchronous motors
- adopt the control methods and topologies of SRM, Stepper motor and PMBLDC motor.
- analyze the performance characteristics of linear induction motor and servo motors.
- employ special synchronous motors to a suitable application.

Course Content

UNIT - I: Switched Reluctance Motor

Principle of operation – Design of stator and rotor pole arc – Power converter for switched reluctance motor – Control of switched reluctance motor.

UNIT - II: Stepper Motors

Construction – Principle of operation – Theory of torque production – Hybrid stepping motor – Variable reluctance stepping motor – Open loop and closed loop control.

UNIT - III: Permanent Magnet DC Motors

Construction – Principle of working – Torque equation and equivalent circuits – Performance characteristics – Moving coil motors.

UNIT - IV: Permanent Magnet Brushless DC Motor

Construction – Principle of operation – Theory of brushless DC motor as variable speed synchronous motor – Sensor less and sensor-based control of BLDC motors.

UNIT - V: Linear Motors

Linear induction motor: Construction– principle of operation– applications. Linear synchronous motor: Construction – principle of operation– applications.

UNIT - VI: Other Motors

Ac series motor, Universal motor, DC and AC servo motor.

Text Books

1. Special electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.
2. Brushless Permanent magnet and reluctance motor drives, Clarendon press, T.J.E. Miller, 1989,Oxford.

Reference Books

1. Special electrical machines, E.G. Janardhanan, PHI learning private limited, 2014.
2. Electrical motor drives- modelling analysis and control, R. Krishnan, PHI learning private limited, 2014.

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DIGITAL CONTROL SYSTEMS

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the concepts on digital control systems and their associated components.
- To impart knowledge on z–transformations for the analysis of digital control systems.
- To familiarize with the concepts on state model representation of discrete–time systems and its stability testing methods.
- To impart knowledge on design of state feedback controller using pole placement method.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- specify the components of digital control systems.
- employ z–transformations to analyze digital control systems.
- assess the stability of digital systems and suggest methods to improve stability margins.
- employ the state–space representation for the analysis and design of digital systems.

Course Content

UNIT - I: Introduction and Signal Processing

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Signals and processing – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT - II: Z–Transformations

Z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT - III: State Space Analysis and the Concepts of Controllability and Observability

State Space Representation of discrete time systems – State transition matrix and Electrical and Electronics Engineering 182 methods of evaluation – Discretization of continuous – Time state equations – Concepts of controllability and observability – Tests (without proof).

UNIT - IV: Stability Analysis

Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips – Stability criterion – Modified routh's stability criterion and jury's stability test.

UNIT - V: Design of Discrete–Time Control Systems by Conventional Methods

Transient and steady state specifications – Design using frequency response in the w–plane for lag and led compensators – Root locus technique in the z– plane.

UNIT - VI: State Feedback Controllers

Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

Text Books

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.

Reference Books

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control and State Variable Methods by M.Gopal, TMH.

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Professional Elective - VI

UTILIZATION OF ELECTRICAL ENERGY

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To impart knowledge on electric heating and welding methods for residential, commercial and industrial applications.
- To familiarize with the fundamental laws of illumination, working principles of different lamps, basic concepts of electric traction and electric braking.

Learning Outcomes:

Upon successful completion of the course, the students will be able to

- describe various electric heating and welding methods.
- design illumination systems for residential, commercial and industrial environments.
- analyze various speed time curves of electric traction.
- determine the tractive effort, power and specific energy consumption of electric traction.

Course Content

UNIT - I: Electric Heating

Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT - II: Electric Welding

Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT - III: Illumination

Introduction to sources of light, terms used in illumination, laws of illumination, basic principles of light control, illumination levels for various purposes.

UNIT - IV: Methods of Illumination

Types of Lamps: Discharge lamps, MV and SV lamps, tungsten filament lamps and fluorescent tubes, Comparison between tungsten filament lamps and fluorescent tubes, design of interior and exterior lighting systems.

UNIT - V: Electric Traction – I

Systems of electric traction and track electrification. Review of existing electric traction systems in India, Special features of traction motor, Mechanics of train movement, Speed-time curves for different services, trapezoidal and quadrilateral speed time curves

UNIT - VI: Electric Traction – II

Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

Text Books:

1. Utilization of Electric Energy by Garg and Giridhar, Khanna Publishers, First Edition, 1982.
2. Art & Science of Utilization of electrical Energy by H.Partab, Dhanpat Rai & Sons, second edition, 1999.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric Traction by N.V.Suryanarayana, New Age International (P) Limited, First Edition, 1996.
2. Generation, Distribution and Utilization of electrical Energy by C.L. Wadhwa, Wiley Eastern Limited, second edition, 1997.

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Professional Elective - VI

HVDC TRANSMISSION SYSTEMS

IV Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the concepts of HVDC Transmission.
- To familiarize with various converters , controllers and networks used in HVDC Transmission.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design the voltage level and ratings of the HVDC system for a given amount of power transfer.
- identify the suitable converter and its control scheme in HVDC Transmission.
- estimate the amount of reactive power to be compensated for a given HVDC Transmission system.
- develop a suitable model for a given AC- DC network
- choose appropriate protecting device for various faults in HVDC stations.
- design a suitable filter to eliminate harmonics in the HVDC System.

UNIT - I: Basic Concepts

Economics & terminal equipment of HVDC transmission systems: types of HVDC links – apparatus required for HVDC systems – comparison of AC &DC transmission, application of DC transmission system – planning & modern trends in D.C. transmission.

UNIT - II: Analysis Of HVDC Converters

Choice of Converter configuration – analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters –Cases of two 3 phase converters in star –star mode – their performance. Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

UNIT - III: Reactive Power Control And In HVDC

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies sources of reactive power-AC Filters – shunt capacitors synchronous condensers.

UNIT - IV: Power Flow Analysis in AC/DC Systems

Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for D.C. quantities-solution of AC-DC Power flow-Simultaneous method-Sequential method.

UNIT - V: Converter Faults

Converter faults – protection against over current and over voltage in converter station – surge arresters – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

UNIT - VI: Harmonics & Protection

Generation of Harmonics, Characteristics and Non- Characteristics harmonics, Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics. Types of AC filters, Design of Single

tuned filters –Design of High pass filters.

Text Books

1. HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar, New Age International (P) Limited Publishers, First Edition, 2005.
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao. Khanna Publishers, 1990.

Reference Books

1. HVDC Transmission – J.Arrillaga. published by the institution of electrical engineering, London, UK, 1998.
2. Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons, First Edition.
3. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications, First Edition.

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Professional Elective - I

NON CONVENTIONAL SOURCES OF ENERGY

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on non-conventional sources of energy and techniques used in exploiting solar, wind, tidal and geothermal sources of energy and bio-fuels.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- significance of renewable energy and describe the principles of solar radiation
- analyze various solar collectors.
- know the various storage methods and application of solar energy.
- understand the concept of converting wind energy into electrical energy using both horizontal and vertical axis wind machines.
- know biomass disasters, functional operation of geothermal systems.
- generalize the operation of ocean, tidal and wave energy systems.
- understand the operating principle of direct energy conversion systems .and to recognize the need and ability to engage in lifelong learning for further developments in this field.

Course Content

UNIT - I: Introduction

Energy sources and their availability- commercial and non commercial energy sources. Need of Renewable Energy Sources (RES), classification of RES, Role and potential of RES in India.

Solar Radiation: Structure of the sun, Solar constant, environmental impact of solar radiation, Radiation at the earth surfaces, solar radiation Geometry, extraterrestrial and terrestrial solar radiation, Spectral Distribution of Extraterrestrial Radiation, solar radiation on tilted surfaces and Empirical equations for predicting the availability of solar radiation at any given location. Solar energy - Thermal applications.

UNIT - II: Solar Collectors

Principle of solar energy conversion into heat, classification of solar collectors, Flat plate collectors, basic energy balance equation, collector efficiency, thermal analysis of flat plate collector. Concentrating collectors and its advantages and disadvantages. Performance analysis of concentrating collectors, selection of absorber coating materials.

UNIT - III: Solar Energy Storage and Applications

Solar Energy Storage: Different storage methods- sensible, latent heat and stratified storage, solar ponds.

Solar Energy Applications: Solar water, space heating /cooling, solar thermal electric conversion, direct solar electric power generation- solar photovoltaic, solar distillation, Solar Pumping, Solar furnace, Solar cocking and solar green house.

UNIT - IV: Wind Energy, Biomass Energy Conversion Systems and Geothermal Thermal Energy

Wind Energy: Working principle of wind energy conversion, Wind patterns, Components of wind energy conversion system (WECS), Types of Wind machines – horizontal axis and vertical axis, Betz coefficient.

Biomass Energy Conversion Systems: Biomass Energy: Fuel classification – Pyrolysis – Different digesters and sizing.

Geothermal Thermal Energy: Classification – Dry rock and acquifer – Energy analysis

UNIT - V: Ocean Thermal Energy, Tidal Power System and Wave Energy

Ocean Thermal Energy: Method s of Ocean Thermal Electric power generation- Open cycle systems, closed cycle systems

Tidal Power System: Working principle, components of Tidal Power plant, single basin and double basin tidal energy system advantages and limitations .

Wave Energy: Wave energy conversion Devices-wave energy conversion by floats, high level reservoir wave machine and dolphin type wave power machine. Advantages and disadvantages

UNIT - VI: Direct Energy Conversion, MHDPower Generation and Fuel Cell

Direct Energy Conversion (DEC): Need for DEC, limitations, principles of DEC. Thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators

MHD Power Generation: Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion.

Fuel Cell: working principle, classification – Efficiency – VI characteristics.

Text Books

1. SP Sukhatme, "Solar Energy: Principles of thermal collection and storage" Tata McGraw Hill
2. Tiwari and Ghosal, "Renewable energy resources", Narosa

Reference Books

1. B.H.Khan "Non – conventional Energy Resources" Tata McGraw Hill education Pvt. Ltd.
2. G.D. Rai, "Non-Conventional Energy Sources", Dhanpat Rai and Sons
3. Twidell & Weir, "Renewable Energy Sources ".

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Professional Elective - I

MECHANICAL VIBRATIONS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the concepts of mathematical model and solution methods for vibrations of the mechanical systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- appreciate the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.
- analyze the mathematical model of a linear vibratory system to determine its response
- model single degree and two degree vibratory systems and determine their responses
- determine the natural frequencies and mode shapes of continuous vibratory systems using numerical methods
- choose appropriate instrument to measure the vibrations

Course Content

UNIT - I: Fundamentals of Vibration

Introduction, Elements of vibrating system , types of vibrations, methods of vibration analysis , spring elements , mass or inertia elements, damping elements , simple harmonic motion.

UNIT - II: Free Vibrations of Single Degree of Freedom Systems

Undamped Free Vibrations: Governing differential equation , Newton's method , Energy method, Rayleigh's method, torsional system – equations of motion and solution.

Damped Vibrations: Governing differential equation, critical damping coefficient and damping ratio, damped natural frequency, logarithmic decrement, energy dissipated in viscous damping.

UNIT - III: Forced Vibrations of Single Degree of Freedom Systems

Sources of Excitation , Equations of motion , Response of undamped system under harmonic excitation, Total response , beating phenomenon , Response of damped system under harmonic excitation, frequency response , quality factor and band width , response under harmonic excitation of the base, vibration isolation, transmissibility, force transmission to foundations, response of a damped system under rotating unbalance.

UNIT - IV: Two Degree of Freedom Systems

Vibrations of undamped system , torsional system , damped free vibrations, forced harmonic vibration , coordinate coupling and principal coordinates , torsional vibration absorber , centrifugal pendulum absorber

UNIT - V: Vibrations of Continuous Systems

Lateral Vibrations of springs, longitudinal vibrations of bars , transverse vibrations of beams.

UNIT - VI: Vibration Measurement

Transducers - variable resistance transducers , piezoelectric transducers, electro dynamic transducers, linear variable differential transformer, transducer vibration pickups- vibrometer, accelerometer , velometer , frequency measuring instruments , vibration exciters- mechanical exciters, electrodynamic shaker , signal analysis-spectrum analyzers

Text Books

1. S. S. Rao , Mechanical Vibrations , 4th Edition, Pearson-Prentice Hall
2. William T. Thomson and Marie Dillon Dahleh ,Theory of Vibration with Application,Pearson New International Edition,5th Edition.

References Books

1. G.S. Grover &S.P.Nigam ,Mechanical Vibrations ,Nem Chand & Bros, 8th edition,
2. V.P.Singh ,Mechanical vibration,Dhanpat Rai & Co ,4th Edition.
3. Mechanical vibration Schaum Series , McGraw Hill ,2nd Edition.

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Professional Elective - I

MECHANICS OF COMPOSITE MATERIALS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the composite materials and their mechanical behaviour.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the concepts of composite materials.
- select a best technique for fabrication of composite material.
- analyze macro and micro mechanical behaviour of a lamina.
- develop governing equations for bending, buckling and vibrations in laminated plates.
- analyze and design composite structures used in automobile and aerospace applications.

Course Content

UNIT - I: Introduction to Composite Materials

Introduction, What is a composite material, Current and potential advantages of fibre reinforced composites, Applications of composite materials, Military, civil, space, automotive and commercial applications.

UNIT - II: Fabrication of Composites

Fabrication of Metal Matrix Composites, Fabrication of Polymer Matrix Composites, Fabrication of ceramic matrix composites, Fabrication of nano-composites.

UNIT - III: Macro and Micro Mechanical Behaviour of a Lamina

Stress strain relations for anisotropic materials, Restrictions on engineering constants, Strengths of an orthotropic lamina, Biaxial strength criteria for orthotropic lamina.

UNIT - IV: Micro Mechanical Behaviour of Lamina and Laminates:

Mechanical of material approach to stiffness, Elasticity approach to stiffness, Classification lamination theory, Special cases, strength of laminates

UNIT - V: Bending, Buckling and Vibration of Laminated Plates

Governing equations for bending buckling and vibration of laminated plates, Deflection of simply supported laminated plates, Vibration of simply supported laminated plates

UNIT - VI: Design of Composite Structures

Introduction, design philosophy, Anisotropic analysis, Bending extension coupling, Micromechanics, Non linear behaviour, Interlaminar stresses, transverse shearing, Laminate optimization.

Text Books

1. Ronald F. Gibson, Principles of composite material mechanics, CRC Press, 2011.
2. Robert M Jones, Mechanics of Composite Materials, Taylor & Francis, 2000V.

Reference Book

1. Lawrence E. Nielsen, Nielson, Paul Nielsen, Mechanical Properties of Polymers and Composites, Second Edition, CRC press, 2000.

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Professional Elective - I

DATA STRUCTURES

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart knowledge of linear and non-linear data structures.
- To familiarize with different sorting and searching techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the working process of sorting (bubble, insertion, selection and heap) and searching (linear and binary) methods using a programming language.
- design algorithms to create, search, insert, delete and traversal operations on linear and non-linear data structures.
- evaluate the arithmetic expressions using stacks.
- choose appropriate collision resolution techniques to resolve collisions.
- compare array and linked list representation of data structures.

Course Content

UNIT - I: Sorting and Searching

Introduction- Concept of data structures, overview of data structures.

Searching: Linear search, Binary search.

Sorting (Internal): Basic concepts, sorting by: insertion (insertion sort), selection (selection sort), exchange (bubble sort).

UNIT - II: Linked Lists

Linked Lists- Basic concepts and operations of single linked list, circular linked list and double linked list.

UNIT - III: Stacks and Queues

Stack: Introduction, representation using arrays and linked list, operations on stack, evaluation of arithmetic expression.

Queue: Introduction, representation using arrays and linked list, operations on queue, circular queue.

UNIT - IV: Trees

Binary Trees: Basic tree concepts, properties, representation of binary trees using arrays and linked list, binary tree traversals.

Binary Search Trees: Basic concepts, BST operations: search, insertion, deletion and traversals, creation of binary search tree from in-order and pre (post) order traversals.

UNIT - V: Heap Trees and Graphs

Heap Trees: Basic concepts, operations, application-heap sort.

Graphs- Basic concepts, representations of graphs, graph traversals-breadth first search and depth first search techniques.

UNIT - VI: Hashing

Hashing: Basic concepts, hashing functions (division method, multiplication method), collision resolution techniques- open hashing and closed hashing.

Text Books

1. Horowitz, Sahani, Anderson Freed, "Fundamentals of Data Structure in C", 2nd edition, University Press.
2. Richard F, Gilberg, Forouzan, "Data Structures", 2nd edition, Cengage.

Reference Books

1. G. A. V. Pai, "Data Structures and Algorithms", TMH.
2. Debasis Samanta, "Classic Data Structures", 2nd edition, PHI.

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Optional Elective - III

COMPUTER GRAPHICS

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce computer graphics applications and functionalities of various graphic systems.
- To familiarize with 2D and 3D geometrical transformations.
- To disseminate knowledge on the visible surface detection and animation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design a conceptual model for the mathematical model to determine the set of pixels to turn on for displaying an object.
- analyze the functionalities of various display devices and visible surface detection methods.
- analyze the performance of different algorithms to draw different shapes.
- choose different transformations and viewing functions on objects.
- apply raster animations for Engine oil advertisements.

Course Content

UNIT - I: Introduction

Introduction: Application of computer graphics, raster scan and random scan Displays.

Filled Area Primitives: Points and lines, inside and outside tests, line drawing algorithms, Scan line polygon fill algorithm.

UNIT - II: 2-D Geometrical Transforms

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transformations.

UNIT - III: 2D Viewing

The viewing pipeline, window to view-port coordinate transformation, Cohen-Sutherland line clipping algorithm, Sutherland –Hodgeman polygon clipping algorithm.

UNIT - IV: 3D Geometric Transformations

Translation, rotation, scaling, reflection and shear transformations, composite transformations, types of projections.

UNIT - V: Visible Surface Detection Methods

Classification – types, back-face detection, depth-buffer, BSP tree, area sub-division method.

UNIT - VI: Computer Animation

Animations: General computer animation, raster animation, key frame systems, Graphics programming using OpenGL: Basic graphics primitives, drawing three dimensional objects, drawing three dimensional scenes.

Text Books

1. Donald Hearn, M.Pauline Baker, "Computer Graphics C version", 2nd Edition, Pearson Education.
2. Francis S. Hill, Stephen M. Kelley, "Computer Graphics using OpenGL", 3rd edition, Pearson Education.

Reference Books

1. Foley, VanDam, Feiner, Hughes, "Computer Graphics Principles and Practice", 2nd edition, Pearson Education.
2. Rajesh K Maurya, "Computer Graphics with Virtual Reality Systems", Wiley.

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Optional Elective - III

FUZZY LOGIC SYSTEMS

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on fundamentals of fuzzy sets and defuzzification.
- To familiarize with the Fuzzy Logic systems

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe applications regarding fuzzy mathematics.
- describe and develop decision making mechanism with fuzzy logic.
- analyze fuzzy logic sets to develop fuzzy logic controllers.
- analyze fuzzy logic system components to develop fuzzy logic controllers.

Course Content

UNIT - I:

Introduction – Fuzzy subsets – Lattices and Boolean Algebras – L fuzzy sets.

Operations on fuzzy - *á* levels sets – properties of fuzzy subsets of a set.

UNIT - II:

Algebraic product and sum of two fuzzy subsets – properties satisfied by addition and product – Cartesian product of fuzzy subsets.

UNIT - III:

Algebra of fuzzy relations – logic – connectives, Fuzzy invariant subgroups - fuzzy subrings.

UNIT - IV:

Fuzzy sets, Membership, operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT - V:

Fuzzification, Membership value assignment, development of rule base and decision making ystem,

UNIT - VI:

Defuzzification to crisp sets, Defuzzification methods.Fuzzy Logic

Text Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
2. Neural Networks and Fuzzy logic System by Bart kosko, PHI Publications
3. Recommended Text S.Nanda and N.R.Das "Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi.

Reference Books

1. Fuzzy Logic with Engineering Applications, Second Edition, Wiley Publications, Timothy J.Ross.
2. Fuzzy Set Theory and Its Applications, Fourth Edition,Yes Dee Publishing Pvt. Ltd., Springer, H.-J. Zimmermann.

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Optional Elective - III

MICRO PROCESSORS AND INTERFACING

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the architecture of 8086 microprocessor.
- To introduce the assembly language programming concepts of 8086 processor.
- To impart knowledge on I/O interfacing.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the architecture of 8086 microprocessor.
- develop programs to run on 8086 microprocessor based system.
- design system using memory chips and peripheral chips for 8086 microprocessor.
- know the concepts of interrupts and serial communication using 8086.

Course Content

UNIT - I: Introduction to 8086

Features of 8086 processor, architecture-functional diagram, register organization, memory segmentation, physical memory organization, signal descriptions of 8086-common function signals, minimum and maximum mode signals, timing diagrams.

UNIT - II: Instruction Set and Addressing Modes of 8086

Instruction formats, instruction set, addressing modes

UNIT - III: Assembly language programming of 8086

Assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

UNIT - IV: Basic Peripheral Interfacing to 8086

8255 PPI-Various modes of operation and interfacing to 8086, interfacing keyboard, display, stepper motor interfacing, D/A and A/D converter.

UNIT - V: Memory Interfacing and Interrupt Structure of 8086

Memory interfacing to 8086, need for DMA, architecture of 8257,interfacing DMA controller 8257 to 8086,interrupt structure of 8086, vector interrupt table, interrupt service routine, interfacing 8259 to 8086.

UNIT - VI: Serial Communication Using 8086

Serial communication standards, serial data transfer schemes, 8251 USART architecture and interfacing, RS- 232, IEEE-4-88, prototyping and trouble shooting.

Text Books

1. D. V. Hall, "Microprocessors and Interfacing", TMGH, 2^{nd} edition.
2. Barry B.Brey, "The Intel Microprocessors –architecture, interfacing and programming", PHI, 8^{th} edition.

Reference Books

1. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", 2^{nd} edition, TMGH.
2. Triebel & Singh, "The 8088 & 8086 Microprocessors-Programming, interfacing, Hardware & Applications", PHI.

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Professional Elective - II

PRINCIPLES OF FINETE ELEMENT METHODS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the basic concepts of finite element method and its applications to structural and heat transfer problems

Learning Outcomes

Upon successful completion of the course, the students will be able to

- derive displacement and stress-strain relationships and solve differential equations by variational and weighted residual methods.
- determine the elongation, stresses and strains in one dimensional bars and trusses subjected to different loads.
- determine the deflections in beams subjected to concentrated and distributed loads.
- compute stress and strains in two dimensional problems using constant strain triangle and iso parametric elements.
- analyze plate bending problems using bending elements.
- evaluate the temperature distribution in one dimensional thin plates and fins

Course Content

UNIT - I:

Introduction: stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational Rayleigh-Ritz and Galerkin weighted residual methods

Finite Element Method: Discretization, types of elements, interpolation functions, local and global coordinates, steps in finite element method, applications of finite element method.

UNIT - II:

Bars and trusses: One dimensional bar element - shape functions – stiffness matrix and load vector– assembly of matrices – treatment of boundary conditions, one dimensional quadratic element, stiffness matrix for plane truss, simple trusses problems.

UNIT - III:

Analysis of Beams: Beam element - shape functions and element stiffness matrix, load vector for concentrated and uniformly distributed load, simple problems on beams.

UNIT - IV:

Two Dimensional Problems: Finite element modeling of two dimensional problems – plane stress and plane strain , constant strain triangular element: strain and nodal displacement relations, load vectors for traction forces on the edges. isoparametric, subparametric and super parametric elements.

UNIT - V:

Plate bending elements: Bending of thin plates, formulation of triangular and rectangular elements, bending of thick plates-basic principles of formulation, shear locking.

UNIT - VI:

Steady state heat transfer analysis: One dimensional thermal analysis of thin plane walls, element conductivity matrix and load vector-assembly of matrices-treatment of boundary conditions, composite wall and analysis of a fin.

Text Books

1. Chandraputla, Ashok and Belegundu, "Introduction to Finite Elements in Engineering" Prentice – Hall.
2. JN Reddy, "Introduction to Finite Element Method", McGrawHill Education.

Reference Books

1. S.S. Rao, "The Finite Element Methods in Engineering",Butter Worth Hienmann Publishers.
2. Daryl L Logan, "A first course in finite element method", Cengage Learning.
3. P.Seshu , Finite Element Analysis, Prentice Hall Publishers.

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ROBOTICS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with anatomy, kinematics, sensors and dynamics of a programmable machine, robot.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between fixed automation and programmable automation.
- identify various components of robot.
- select appropriate type of actuator for a joint.
- illustrate robot applications in manufacturing.
- analyze kinematics of a robot.
- develop equations of motion of a manipulator for a given application.
- create a trajectory plan for execution of a work cycle.

Course Content

UNIT - I:

Introduction: Automation and Robotics, Components of Robot – Mechanical manipulator-control system and end effectors-Types of end effectors — Requirements and challenges of end effectors classification of robots by coordinate system and control system. Control resolution, accuracy, repeatability and work volume of robot.

UNIT - II:

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric &

stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocitysensors.

UNIT - III:

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing operations - spot and continuous arc welding & spray painting - Assembly and Inspection.

Future applications of robots.

UNIT - IV:

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – Problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT - V:

Differential transformations and manipulator Jacobian – Problems,

Dynamics: significance of dynamic modelling of a robot, Lagrange – Euler formulation- LE formulation for inverted pendulum and two degree of freedom RR manipulator

Newton – Euler formulation –basic treatment.

UNIT - VI:

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint integrated motion

straight line motion – Robot programming, lead through programming and textual language programming.

Text Books

1. Groover M P ,"Industrial Robotics", TMH.
2. Mittal R K &Nagrath I J,"Robotics and Control", TMH.

Reference Books

1. Richard D. Klafter,"Robotic Engineering", Prentice Hall.
2. P. Coiffet and M. Chaironze,"An Introduction to Robot Technology", Kogam Page Ltd. 1983 London.
3. Asada,"Robot Analysis and Intelligence", Wiley Inter-Science.
4. John J Craig ,"Introduction to Robotics",Pearson Edu.
5. Mark W. Spong and M. Vidyasagar,"Robot Dynamics &Control",John Wiley & Sons (ASIA) Pvt Ltd.

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Professional Elective - II

AUTOMOBILE ENGINEERING

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart knowledge on IC engines, engine systems and combustion phenomenon.
- To familiarize with the various automotive systems such as transmission system, steering system, suspension system, braking system, safety systems and hybrid vehicles.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- illustrate working of IC engine components.
- analyze the combustion phenomenon in S.I and C.I engines.
- explain transmission, suspension, steering and braking , and safety systems of an automobile.
- list out various emission norms and propose various emission control methods.
- describe the importance of hybrid vehicles.

Course Content

UNIT - I:

I.C. Engine Components: Construction and working of S.I and C.I engines, Engine Systems: Simple and modern Carburettors, Fuel Injection System, Ignition, Cooling and Lubrication, Super charging and Turbo charging.

UNIT - II:

Combustion in S.I. Engines: Stages of combustion, Effect of engine variables on Ignition lag and flame propagation, abnormal combustion- pre-Ignition and knocking, effect of engine variables on Knocking, Octane rating.

Combustion in C.I. Engines: Stages of combustion, Delay period and its importance, Effect of engine variables, Diesel Knock, Cetane rating, comparison of knocking in SI and CI engines.

UNIT - III:

Automobile components: Chassis, Body, Power unit, Power transmission- front wheel drive, rear wheel drive, four-wheel drive, classification of automobiles.

Transmission system: Functions and types of clutches- cone clutch, single plate clutch, multi plate clutch, centrifugal and semi centrifugal clutch, Types of gear boxes- Sliding mesh, Constant mesh, Synchromesh, propeller shaft, universal joint and differential, wheels and tyres.

UNIT - IV:

Steering System: steering geometry, condition for correct steering, steering gears, power steering.

Suspension System: Objectives of suspension system, front suspension system-rigid axle suspension system, independent suspension system, rear axle suspension, torsion bar, shock absorber.

UNIT - V:

Braking System: Mechanical brakes, hydraulic brakes-master cylinder, wheel cylinder, tandem master cylinder, brake fluid, air brakes and vacuum brakes.

Safety Systems: seat belt, air bags, bumper, antilock brake system(ABS), wind shield, central locking, electric windows, Suspension sensor.

UNIT - VI:

Emissions from Automobile: Emission norms - Bharat stage and Euro norms. Engine emissions - exhaust and non-exhaust. Emission control methods.

Hybrid vehicles: Introduction, classification of electrical drive vehicles, types of hybrid vehicles, Concepts of hybrid electric drive train, series and parallel hybrid electric drive train, merits and demerits.

Text books

1. M. L. Mathur, R. P. Sharma "A Course in Internal Combustion Engines", Dhanpat Rai & Sons (2010).
2. Kirpal Singh, "Automobile Engineering Vol-1 & Vol-2", Standard Publishers Distributors, 11th edition.

Reference Books

1. V. Ganesan "Internal Combustion Engines", Tata McGraw Hill Education
2. William H Crouse & Donald L Anglin, Automotive Mechanics, Tata Mc Graw Hill Publications, 10th edition.
3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, New York, 2011.
4. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.

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Professional Elective - II

DATABASE MANAGEMENT SYSTEMS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize the concepts of database systems and different issues involved in the database design.
- To introduce how to write SQL for storage, retrieval and manipulation of data in a relational database.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- recognize the importance of database system over file processing system.
- analyze an information storage problem and derive an information model in the form of an entity relationship diagram.
- write simple and complex queries using Structured Query Language (SQL) for storage, retrieval and manipulation of data in a relational database.
- employ principles of normalisation for designing a good relational database schema.
- describe the issues and techniques relating to concurrency and database recovery in a multi-user database environment.

Course Content

UNIT - I: Introduction to Database

Introduction, advantages of using DBMS, data models, levels of abstraction, entity-relationship model: attributes and keys, relationship types, weak entity set, strong entity set, Specialization and generalization, database design for banking enterprise, reduction to relational schemas.

UNIT - II: Relational Model and SQL

Relational Model: Basic concepts, schema and instances, keys, relational algebra, SQL: DDL, DML, integrity constraints, defining different constraints on a table, set operations, aggregate functions, group by and having clauses, nested queries.

UNIT - III: Database Design

Functional dependencies: Partial, full, transitive and trivial dependencies, Axioms, Decomposition: Lossless Join and dependency preserving decomposition, attribute closure, Normal forms: 1NF, 2NF, 3NF and BCNF.

UNIT - IV: Transaction Management

Transaction concept, ACID properties, transaction state diagram, schedules-serial, concurrent and serializable schedules, serializability- conflict and view serializability, recoverability.

UNIT - V: Concurrency Control

Concurrency Control- Concurrent execution of transactions, anomalies due to concurrent execution, lock-based protocols-2PL, Strict 2PL and Rigorous 2PL, timestamp-based protocols, Thomas write rule, deadlock handling-deadlock prevention, deadlock detection and recovery.

UNIT - VI: Crash Recovery

Crash Recovery - Failure classification, different types of recovery techniques: deferred update, immediate update, shadow paging, checkpoints.

Text Books

1. Korth and Sudarshan, "Database system concepts", 3rd edition, MH.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd edition, MH

Reference Books

1. Elmasri Navate, "Fundamentals of Database Systems", 5th edition, Pearson Education
2. C.J.Date, "Introduction to Database Systems", 8th edition, Pearson Education
3. Peter Rob and C Coronel, "Database Systems Design, Implementation, and Management", 7th edition.

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Optional Elective - V

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of object oriented programming.
- To impart the knowledge of AWT components in creation of GUI.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply Object Oriented approach to design software.
- create user defined interfaces and packages for a given problem.
- develop code to handle exceptions.
- implement multi tasking with multi threading.
- develop Applets for web applications.
- design and develop GUI programs using AWT components.

Course Content

UNIT - I: Fundamentals of OOP and Java

Need of OOP, principles of OOP languages, procedural languages vs. OOP, Java virtual machine, Java features.

Java Programming constructs: variables, primitive data types, identifiers, keywords, literals, operators, arrays, type conversion and casting.

UNIT - II: Class Fundamentals and Inheritance

Class fundamentals, declaring objects, methods, constructors, this keyword, overloading methods and constructors, access control.

Inheritance- Basics, types, using super keyword, method overriding, dynamic method dispatch, abstract classes, using final with inheritance, Object class.

UNIT - III: Interfaces and Packages

Interfaces: Defining an interface, implementing interfaces, nested interfaces, variables in interfaces and extending interfaces.

Packages: Defining, creating and accessing a package.

UNIT- IV: Exception Handling and Multithreading

Exception Handling- exception-handling fundamentals, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, user-defined exceptions.

Multithreading-Introduction to multitasking, thread life cycle, creating threads, synchronizing threads, thread groups.

UNIT - V: Applets and Event Handling

Applets- Concepts of applets, differences between applets and applications, life cycle of an applet, creating applets.

Event Handling- Events, event sources, event classes, event listeners, delegation event model, handling mouse and keyboard events, adapter classes.

UNIT - VI: AWT

The AWT class hierarchy, user interface components-label, button, checkbox, checkbox group, choice, list, text field, scrollbar, layout managers –flow, border, grid, card, gridbag.

Text Books

1. Herbert Schildt, "Java - The Complete Reference", 7th edition, TMH.
2. Sachin Malhotra, Saurabh choudhary, "Programming in Java", 2nd edition, Oxford.

Reference Books

1. Joyce Farrel, Ankit R.Bhavsar, "Java for Beginners", 4th edition, Cengage Learning.
2. Y.Daniel Liang, "Introduction to Java Programming", 7th edition, Pearson.
3. P.Radha Krishna, "Object Oriented Programming through Java", Universities Press.

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Optional Elective - V

MECHATRONICS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on design of complex engineering systems using sensors, actuators, controllers.
- To familiarize with the intelligent systems used in Mechatronics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the elements of Mechatronic Systems
- select suitable sensors, actuators and controllers to meet specific requirements
- draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristic and membership functions respectively.

Course Content

UNIT - I:

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach, advantages and disadvantages of Mechatronics systems.

UNIT - II:

Sensors and Transducers: Types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature, light sensors and micro sensors.

UNIT - III:

Review of fundamentals of electronics. Data conversion devices, signal processing devices, relays, contactors and timers. Microprocessors, microcontrollers and PLCs.

UNIT - IV:

Actuators: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems. Description of PID Controllers.

UNIT - V:

Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits.

Pneumatics: Production, distribution and conditioning of compressed air, system components and graphic representations.

Electro hydraulic, Electro pneumatic and hydro pneumatic servo systems.

UNIT - VI:

Fuzzy Set Theory: Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of membership function, Fuzzy extension principle, Fuzzy Systems: fuzzification and defuzzification and fuzzy controllers.

Text Books

1. Bolton. W, "Mechatronics", Addison Wesley, 4th Edition, New Delhi.
2. Dan Nesulescu, "Mechatronics", 3rd Edition, Pearson Education
3. Michael B. Histand and David G. Aliatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill

Reference Books

1. Devadas Shetty, Richard A Kolk, "Mechatronics System Design",
2. B.P. Singh (2002), "Advanced Microprocessor and Microcontrollers" New Age International Publisher.
3. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
4. H.J.Zimmermann, Fuzzy Set Theory and Its Applications, 2nd Ed., Kluwer Academic Publishers, 1996.
5. S.N. Sivanandam and S.N.Deepa, "Principles of Soft Computing" Second Edition, Wiley India Pvt.Ltd.

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Optional Elective - V

EMBEDDED SYSTEM DESIGN

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of embedded system design and to show how such systems are developed using a concrete platform built around.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between the general computing system and the embedded system.
- differentiate general purpose processors and single purpose processors.
- model different state machines and concurrent process.
- specify different design technologies of software and hardware design.

Course Content

UNIT - I: Introduction

Embedded System-Definition, classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, memory, sensors and actuators, communication interface, embedded firmware. Design challenge-Optimizing design metrics, processor technology, IC technology, design technology.

UNIT - II: Single Purpose Processors

RT-level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level), optimizing custom single purpose processors.

UNIT - III: General Purpose Processors

Basic architecture, operation, pipelining, programmer's view, development environment, Application Specific Instruction-Set Processors(ASIPs), micro controllers and digital signal processors.

UNIT - IV: State Machine and Concurrent Process Models

Introduction, models vs languages, finite state machines with data path model (FSMD) using state machines, program state machine model (PSM), concurrent process model.

UNIT - V: Interfacing

Communication basics, arbitration, multilevel bus architectures, advanced communication principles

UNIT - VI: Design Technology

Automation: Synthesis-parallel evolution of compilation and synthesis, synthesis levels, logic Synthesis, RT synthesis, behavioral synthesis, systems synthesis and hardware/software co-design, Verification: hardware/software co-simulation

Text Books

1. Frank Vahid, Tony D. Givargis, "Embedded System Design - A Unified Hardware/Software Introduction", John Wiley.
2. Shibu.K.V, "Introduction to Embedded Systems" - Tata McGraw Hill Education Private Limited.

Reference Books

1. Raj kamal, "Embedded Systems", 2nd edition , TMH.
2. Tammy Noergaard, "Embedded Systems Architecture", 1st edition, Elsevier Publications.

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OPTIMIZATION TECHNIQUES

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce quantitative techniques to solve resourse management problems.
- To know how to formulate allocation problems as LPP, transportation problem and assignment problems and locate solution.
- To familiarize with the concepts of queuing theory.
- To understand game theory concepts.

Course Outcomes

Upon successful completion of the course, the students will be able to

- formulate the problem as LPP and to find optimal solution.
- determine optimal distribution & optimal cost.
- find minimal sequence and total elapsed time.
- evaluate operating characteristics in queuing models.
- determine optimal strategies for players.

Course Content

UNIT - I: Linear Programming - I

Introduction to OR, definition, characteristics, Modelling in OR - Classification by structure, Linear Programming problem, Formulation, Solution by Graphical Method.

UNIT - II: Linear Programming - II

Standard form of LPP, Simplex Method, Artificial Variable Technique, Big-M method, Duality principle, Rules to convert primal to dual.

UNIT - III: Transportation-Assignment Problems (Allocation Methods)

Transportation problem – Balanced and Unbalanced, Finding IBFS(North West Corner Rule, Matrix minima Method, VAM) Optimal solution (MODI Method) Degeneracy.

Assignment problems-optimal solution by Hungarian method, Special cases - Unbalanced and maximal assignment problems, Travelling sales man Problem.

UNIT - IV: Job Sequencing

Introduction – Types of sequencing problems-Processing n jobs through two machines, Processing n jobs through three machines and Processing n jobs through m machines.

UNIT - V: Queuing Theory (Waiting line Theory)

Introduction - elements of Queuing system- Operating characteristics-Classification of queuing models: single channel-Poisson arrivals-exponential service times-with infinite and finite population capacity. Multi service channel with infinite queue size.

UNIT - VI: Game Theory

Introduction to game theory, Two Person Zero sum games, Maximin - Minimax principle, Solution of Games with and without saddle points, Dominance property and Graphical solution of 2Xn and mX2 games.

Text Books

1. Kanthi Swarup, P.K.Gupta and Man Mohan, Operations Research, 14th edition, 2008, S. Chand & Sons New Delhi.
2. S.D. Sharma and Himanshu Sharma Operations Research, 15th edition, Kedarnath Ramnath Publishers, 2010.

Reference Books

1. Hamdy A. Taha, Operations Research, 8th edition, PHI Publications, 2008.
2. Billy E. Gillett, Introduction to Operations Research : A Computer-oriented Algorithmic Approach, Tata McGraw-Hill.

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REFRIGERATION AND AIR CONDITIONING

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the basic cycles of various refrigerating systems, their performance evaluation along with details of system components and refrigerant properties.
- To impart knowledge of psychrometric properties, processes which are used in air-conditioning systems for comfort and industrial applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe the working of air refrigeration cycle and its application in aircrafts
- analyze various refrigeration cycles and evaluate their performance under various operating conditions
- classify various components of a refrigeration system
- select the most appropriate refrigerant for a given application and understand the impact of refrigerants on the environment
- estimate the psychrometric properties and analyze the psychrometric processes
- calculate the load acting on an air-conditioning system and select the appropriate process and equipment for the required comfort and industrial air-conditioning.

Course Content

UNIT - I:

Introduction: Need and Applications of refrigeration, Unit of refrigeration and C.O.P, Methods of refrigeration, Ideal and actual cycles of refrigeration.

Air Refrigeration: Bell Coleman cycle, Open and Dense air systems, Actual air refrigeration system. Refrigeration needs of Aircrafts - Air craft refrigeration systems - working and their analysis

UNIT - II:

Vapor Compression Refrigeration: Working principle and essential components of the plant, actual cycle, effect of sub-cooling, super-heating, evaporator and condenser pressures on system performance – use of p-h charts. Cascade refrigeration cycles - A two-stage cascade refrigeration system.

UNIT - III:

Refrigerants: Desirable properties, classification, Nomenclature, Ozone Depletion, Global Warming.

System Components: Classification and working of Compressors, Condensers, Evaporators and Expansion devices.

UNIT - IV:

Vapor Absorption System: Description and working of NH_3 – water system, Calculation of maximum COP and Description and working of Li Br –water (Two shell & Four shell) System, principle of operation of three fluid absorption system, salient features.

Steam Jet Refrigeration System - Working Principle and basic components and its analysis

Non conventional Refrigeration systems: (i) Thermoelectric refrigerator (ii) Vortex tube

UNIT - V:

Psychrometry & Pshchrometric Processes:

Review of Psychrometric Properties, Psychometric Processes: Sensible heating, sensible cooling, humidification and de-humidification, cooling and de-humidification, cooling with adiabatic humidification, heating and humidification, adiabatic mixing of two air streams.

Requirements of human comfort, concept of effective temperature, Comfort chart, Classification of equipment for cooling, heating, humidification and dehumidification.

UNIT - VI:

Design of Air-Conditioning systems: Characterization of Sensible and latent heat loads, Need for Ventilation, Consideration of Infiltration, Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP. Comfort Air conditioning - summer air conditioning, winter air conditioning, Requirements of Industrial air conditioning, Air conditioning Load Calculations.

Text Books

1. C P Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill Education, 3rd edition.
2. S C Arora & Domkundwar, "A Course in Refrigeration and Air conditioning", Dhanpat Rai publications, 5th edition.
3. Manohar Prasad, "Refrigeration and Conditioning", New Age publications, Revised 2nd edition.

Reference Books

1. Dossat, "Principles of Refrigeration", Pearson Education.
2. Anantha Narayanan, "Basic Refrigeration and Air-Conditioning", Tata McGraw-Hill Education, 4th edition.

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Professional Elective - III

UNCONVENTIONAL MACHINING PROCESS

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart the principles of non-traditional machining methods.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- justify the need of non-traditional machining methods.
- elaborate the principle and mechanism of metal removal of various unconventional machining processes.
- interpret the various process parameters and their effect on Material Removal Rate of various unconventional machining processes.
- select appropriate unconventional machining process based on mechanism of metal removal.
- summarize the applications of different Unconventional Machining Methods.

Course Content

UNIT - I: Introduction

Need for non-traditional machining methods, classification of modern machining processes – considerations in process selection, applications. Ultrasonic machining – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations.

UNIT - II: Electro – Chemical Machining

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate, fundamentals of chemical, machining, advantages and applications, Electrostream drilling, shaped tube electrolytic machining.

UNIT - III: Thermal Metal Removal Processes

General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface.

UNIT - IV: Exotic Machining Processes

Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications

UNIT - V: Plasma Machining

Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT - VI: Mechanical Methods

Abrasive jet machining, Water jet machining and abrasive water jet machining-Basic principles, equipments, process variables, mechanics of material removal, MRR, application and limitations. Magnetic abrasive finishing, abrasive flow finishing.

Text Books

1. Benedict, Non-traditional machining methods, CRC Press.
2. VK Jain , Advanced machining processes, Allied publishers.

Reference Books

1. Pandey P.C. and Shah H.S, Modern Machining Process TMH.
2. Bhattacharya A, New Technology , The Institution of Engineers, India.

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Professional Elective - III

TRIBOLOGY

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the selection of lubricating system for different machine components

Learning Outcomes

Upon successful completion of the course, the students will be able to

- select the appropriate bearing materials.
- select the rolling element bearing for the given conditions.
- design hydrostatic, hydrodynamic and air lubrication systems used in bearings.
- minimize the boundary friction and dry friction.

Course Content

UNIT - I:

Introduction: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used.

Lubrication: Choice of lubricants, types of oil, grease and solid lubricants-additives- lubrication systems and their selection.

UNIT - II:

Selection of Rolling Element Bearings: Nominal life, static and dynamic capacity-equivalent load, probabilities of survival- cubic mean load -pre loading of bearings, conditioning monitoring using shock pulse method.

UNIT - III:

Hydrostatic Bearings: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT - IV:

Hydrodynamic bearings: Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage – Reynolds equation in three dimensions, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing..

UNIT - V:

Air lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect

UNIT - VI:

Types of bearing materials and bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. General requirements of bearing materials, types of bearing materials.

Text Books

1. Basu, SenGupta and Ahuja , Fundamentals of Tribology, PHI
2. Sushil Kumar Srivatsava , Tribology in Industry, S. Chand &Co.

Reference Books

1. Neale MJ, (Editor) "Tribology hand Book" ,Neumann Butterworths,1975.
2. Connor and Boyd , "Standard hand book of lubrication engineers" ASLE, McGraw Hill Book & Co.,1968.
3. Shigley J, E Charles, "Mechanical Engineering Design", McGraw Hill Co.,6th Edition.

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Professional Elective - IV

TOTAL QUALITY MANAGEMENT

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of Total Quality Management

Learning Outcomes

Upon successful completion of the course, the students will be able to

- investigate and analyze quality management issues in both manufacturing and service industry
- apply total quality management tools like Six sigma , QFD, Taguchi methods etc to improve quality and productivity.

Course Content

UNIT - I: Introduction

Quality and improvement, History and Stages of Evolution, Quality assurance, quality loss function, link between quality and productivity

UNIT - II: Quality Systems

Quality System – Elements, Quality Standards –Need of standardization- Bodies of standardization, ISO 9000- series - ISO 14000 series, Requirements and Benefits.

UNIT - III: Concepts of TQM

Definitions, Philosophy of TQM, Customer focus, Organization, Top management commitment, Contributions of Deming, Juran and Crosby to TQM

UNIT - IV: TQM systems

Quality policy deployment, Quality function deployment, Statistical Process Control-process chart-preparing and using control charts.

UNIT - V: TQM Tools and Techniques I

The seven traditional tools of quality, New management tools-Quality Circles, Bench Marking, KAIZEN, 5S, JIT.

UNIT - VI: TQM Tools and Techniques II

Taguchi analysis- loss function- Six Sigma approach-Application of six sigma approach to various industrial situations – Quality Function Development (QFD)- elements of QFD.

Text Books

1. Dale H.Besterfiled, at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

2. Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993.

Reference Books

1. The Essence of Total Quality Management by John Bank, PHI, 1993

2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.

3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.

4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd.

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Professional Elective - IV

COMPUTATIONAL FLUID DYNAMICS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To equip students with the knowledge that is essential for application of computational fluid dynamics to solve engineering flow problems.
- To provide the essential numerical background for solving the partial differential equations governing the fluid flow.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the mathematical representation of the governing equations of fluid flow.
- classify the partial differential equations
- express derivatives to difference equations through discretization techniques and solve the algebraic equations using iterative techniques
- transform the equations for grid generation and apply implicit/explicit techniques for solving partial differential equations
- solve one dimensional diffusion problems and convection - diffusion problems using finite difference techniques and finite volume method.

Course Content

UNIT - I:

Introduction: Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics.

Governing Equations of Fluid Dynamics: Introduction, Models of the flow - finite control volume, infinitesimal fluid element, Substantial Derivative, Divergence of Velocity, Three dimensional continuity, momentum and energy equations in differential and integral forms. Physical boundary conditions.

UNIT - II:

Mathematical behavior of partial differential equations: Introduction, Classification of Quasi-Linear Partial Differential Equations - Cramer's rule, Eigen value method, behavior of the different classes of differential equations - hyperbolic, parabolic and elliptical equations.

UNIT - III:

Basics Aspects of Discretization: Introduction to Finite Difference approach, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, introduction to finite volume approach.

Solution Techniques for System of Algebraic Equations: iterative solution methods, direct method with Gaussian elimination, direct method with Tri-diagonal matrix algorithm.

UNIT - IV:

Grid Generation Techniques: Introduction, general transformation of the equations, Metrics and Jacobians, Stretched grids, Boundary - fitted coordinate systems

UNIT -V:

Applications of Finite Difference Method: Diffusion problem - One dimensional steady state heat conduction, transient heat conduction, One dimensional convection diffusion problems.

UNIT - VI:

Applications of Finite Volume Method: Diffusion problem - One dimensional steady state heat conduction, transient heat conduction, One dimensional convection diffusion problems.

Text Books

1. John D. Anderson, JR "Computational fluid dynamics The basic with applications", Mc Graw Hill international .
2. H. Versteeg, W Malalsekra , "An Introduction to Computational Fluid Dynamics The finite volume method", Pearson Publishers, 2nd Edition.

Reference Books

1. T. J. Chung - "Computational fluid dynamics", Cambridge university press.
2. Suhas V. Patankar, "Numerical heat transfer and fluid flow" Butter-worth Publishers
3. T. K Sengupta, "Fundamentals of Computational Fluid Dynamics", University Press.

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Professional Elective - IV

CONDITION MONITORING

IV Year – I Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize with the importance of types of maintenance with their limitations and the methods of condition monitoring in different industrial sectors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply different maintenance strategies for the need of plant maintenance to reduce the maintenance cost
- analyze the machine condition with the aid of measuring instruments
- select appropriate test for fault identification of given application
- carry out lubrication oil analysis and temperature analysis for given applications
- analyze the case study including the fault identification and root causes of malfunction.

Course Content

UNIT - I:

Maintenance: Introduction, maintenance strategies, introduction to condition monitoring. rotating machinery - machine faults and root causes, ISO Standards for vibration analysis.

UNIT - II:

Vibration Monitoring: Types and benefits of vibration analysis, vibration signature analysis, **Vibration Measuring Instruments :** Vibration transducers – displacement, velocity and acceleration transducers. vibrometer- introduction, laser vibrometer. accelerometers – piezo resistive, capacitive and inductive type.

UNIT - III:

Non-destructive Testing: Various techniques for fault detection, introduction to non-destructive testing, role of non-destructive testing in condition monitoring.

Flaw Detection: Discontinuity – origin and classification, ultrasonic testing and magnetic particle inspection.

UNIT - IV:

Wear Debris Analysis: Wear mechanisms, wear particles, wear process monitoring techniques – Ferrography - Applications, advantages and limitations, spectrometric oil analysis program (SOAP)

UNIT - V:

Temperature monitoring: Need for temperature monitoring, thermography, active and passive thermography, IR thermography, applications, advantages and limitations.

UNIT - VI:

Case studies: Gear box, induction motor, transformer, roller bearings, wind mill

Text Books

1. R.A. Collacott ," Mechanical Fault Diagnosis and Condition Monitoring ",John Wiley and Sons.

Reference Books

1. Isermann R., "Fault Diagnosis Applications", Springer-Verlag, Berlin, 2011.
2. Rao, J S., "Vibration Condition Monitoring", Narosa Publishing House, 2nd Edition, 2000.
3. Allan Davies,"Handbook of Condition Monitoring", Chapman and Hall, 2000.

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Professional Elective - IV

DESIGN OF TRANSMISSION ELEMENTS

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the design of various machine elements for effective power transmission.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design the transmission elements like belts, ropes, chain drives, shafts, couplings gears, gearbox, power screws under different loading conditions.

Course Content

UNIT - I:

Flat belt Drives and Pulleys: Introduction to belt drives, belt materials, belt tensions, transmission of power by flat belt, design of flat belt drive and pulley.

V-Belt, Rope and Chain Drives: Design and selection of V- belt drives and rope drives, design of pulley for V-belt and rope drive, design of Chain drives.

UNIT - II:

Design of Shafts: Introduction- shaft sizes – BIS code - design of solid and hollow shafts for strength and rigidity – design of shafts for combined loading-torsion, bending and axial.

Design of Keys: Design of keys-stresses in keys.

Design of couplings: Muff, split muff, flanged and bushed pin coupling.

UNIT - III:

Design of power screws: Design of screw - Square, ACME, Buttress screws, design of nut, compound screw, differential screw.

UNIT - IV:

Design of Spur and Helical Gear Drives: Spur gears and helical gears – Forces, Lewis beam strength Equation, Wear load and Dynamic load.

UNIT - V:

Design of Bevel and Worm Gear Drives: Bevel gears and Worm gears – Forces, Lewis beam strength Equation, Wear load and Dynamic load.

UNIT - VI:

Gear box Design- Introduction – types – ray diagram, no. of speed calculation, design of multi speed gear box

Text Books

1. N.C. Pandya and C. S. Shah "Machine design" Charotar Publishing House Pvt. Limited.
2. V.B.Bandari "Introduction to Machine Design", TMH Publishers.

Reference Books

1. Joseph Edward Shigley, Charles R.Mischke , "Mechanical engineering design", TMH Publishers
2. Robert L.Norton, "Machine Design – An integrated approach", 2nd edition, Pearson education India.
3. T.V. Sundaraja Murthy, "Machine Design" Anuradha Publications.
4. Sadhu Singh, "Design of Machaine Elements" Khanna Publishers.

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Optional Elective - VII

BIG DATA ANALYTICS

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the architectural concepts of Hadoop and introducing map reduce paradigm.
- To disseminate knowledge on how to summarize, query, and analyze data with Hive.
- To familiarize with business decisions and create competitive advantage with Big Data analytics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- summarize the importance of Big Data and its problems (storage and analysis).
- outline the building blocks of hadoop and anatomy of file read and write.
- analyze data with hadoop MapReduce.
- generalize how MapReduce works when running a job.
- choose best programming tools for solving real world and industrial problems.

Course Content

UNIT - I: Introduction to Big Data

Big Data, Characteristics of Big Data - The Four V's, Why Big Data is important, data, data storage and analysis, comparison with other systems, brief history of Hadoop, Apache Hadoop and the Hadoop eco system.

UNIT - II: The Hadoop Distributed File System

The design of Hadoop Distributed File System (HDFS), Architecture, Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), Basic file system operations, anatomy of a File read, anatomy of a File write.

UNIT - III: Introduction to Map Reduce

A Weather Dataset, analyzing weather data with UNIX tools, analyzing data with Hadoop, Map and reduce, java map reduce, The old and new Java MapReduce APIs, data flow, combiner functions, running a distributed map reduce job.

UNIT - IV: How Map Reduce works

Anatomy of a MapReduce job run: job submission, job initialization, task assignment, task execution, progress and status updates, job completion; Shuffle and sort: the map side, the reduce side.

UNIT - V: Pig

Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

UNIT - VI: Hive

Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables with Hive, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data.

Text Books

1. Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly.
2. Chuck Lam, "Hadoop in Action", 1st edition, Manning Publications.
3. Dirk deRoos, "Hadoop for Dummies", 1st edition, John Wiley & Sons.

Reference Books

1. Paul Zikopoulos, Chris Eaton, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st edition, TMH.
2. Srinath Perera, Thilina Gunarathne, "Hadoop Map Reduce Cookbook", Packt Publishing.

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Optional Elective - VII

COMPUTER ORGANIZATION AND ARCHITECTURE

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with organizational aspects of memory, processor and I/O.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify different types of instructions.
- differentiate micro-programmed and hard-wired control units.
- analyze the performance of the hierarchical organization of memory.
- demonstrate various operations on fixed and floating point numbers.
- summarize different data transfer techniques.
- demonstrate the use of parallel processing.

Course Content

UNIT - I: Register transfer language and Micro operations

Introduction- Functional units, computer registers, register transfer language, register transfer, bus and memory transfers, arithmetic, logic and shift microoperations, arithmetic logic shift unit.

Basic Computer Organization and Design: Instruction codes, instruction cycle. register reference instructions, Memory – reference instructions, input – output and interrupt.

UNIT - II: CPU and Micro Programmed Control

Central Processing unit: Introduction, instruction formats, addressing modes.

Control memory, address sequencing, design of control unit - hard wired control, micro programmed control.

UNIT - III: Memory Organization

Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory.

UNIT - IV: Computer Arithmetic

Data representation- fixed point, floating point, addition and subtraction, multiplication and division algorithms.

UNIT - V: Input-Output Organization

Peripheral Devices, input-output interface, asynchronous data transfer, modes of transfer- programmed I/O, priority interrupt, direct memory access, Input –Output Processor (IOP).

UNIT - VI: Parallel Processing

Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline.

Multi Processors: Characteristics of multiprocessors, interconnection structures, inter processor arbitration, cache coherence.

Text Books

1. M. Moris Mano, "Computer Systems Architecture", 3rd edition, Pearson/PHI.

Reference Books

1. Carl Hamacher, Zvonks Vranesic, Safea Zaky, "Computer Organization", 5th edition, McGraw Hill.
2. William Stallings, "Computer Organization and Architecture", 6th edition, Pearson/PHI.
3. John L. Hennessy and David A. Patterson, "Computer Architecture a Quantitative Approach", 4th edition, Elsevier.

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Optional Elective - VII

CRYOGENICS

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To study various fluid properties, applications, gas liquefaction systems, air separation techniques, Insulating materials, vacuum pumps used in cryogenics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- discuss various properties of fluids used in cryogenic industry
- describe various gas liquefaction systems
- analyze various gas separation systems
- explain various cryocoolers, heat exchangers
- analyze various vacuum pumps and list various insulating materials
- describe various instruments and sensors used in cryogenics field.

Course Content

UNIT - I:

Introduction to cryogenic engineering, Properties of cryogenic fluids - Hydrogen, Helium, Properties of materials at cryogenic temperature - Mechanical, Electrical, Thermal, super conducting properties.

UNIT - II:

Basics of Refrigeration and Liquefaction, Joule Thomson effect, J – T expansion of a real gas, Adiabatic expansion, Comparison of J – T and Adiabatic expansions, Gas liquefaction systems, Effect of heat exchanger effectiveness on liquefaction systems and Figure of merit.

UNIT - III:

Basics of Gas Separation, Ideal Gas Separation System , Properties of Mixtures and the Governing Laws , Principles of Gas Separation ,Rectification and Plate Calculations.

Professional Elective - V

DESIGN FOR MANUFACTURING AND ASSEMBLY

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the design considerations for manufacturing and assembly.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the principles of design for manufacturing processes
- estimates the cost of dies, molds and machined components based on die life
- employ the design principles for manual assembly and automated assembly
- design typical assemblies using principles of design for X concepts
- use the design rules for machining with single point and multi point cutting tools.

Course Content

UNIT - I: Design for Manufacturing

Overview of the DFM Process, Reduce the cost of manufacturing process, understanding the process and constraints, standard components and process, consider the impact of DFM decisions and other factors.

UNIT - II: Design Consideration in Metal Casting

Mold and gating system design, directional solidification, trouble shooting and ease of assembly and automation.

UNIT - III: Design Considerations for Welding and Forging

Consideration of defects, minimization of the residual stresses and ease of assembly and automation.

UNIT - IV: Design Considerations for Sheet Metal and Powder Metal Process

Consideration of defects, minimization of the residual stresses and ease of assembly and automation.

UNIT - V: Design Considerations in Machining

By considering machinability, geometric factors, cutting conditions and ease of assembly and automation.

UNIT - VI: Selection of Materials

Selection of materials for engineering applications using properties, process, shape, charts, ranking and choice.

Text Books

1. George E. Dieter, "Engineering Design" ,McGraw Hill International, 4th Edition.

Reference Books

1. Geofrey Boothroyd, Peter Dewhurst, "Product Design for Manufacture and Assembly", CRC Press, 3rd Edition.
2. O. Molloy , "Design for Manufacturing and Assembly: Concepts, Architectures and Implementation",Chapman and Hall, 1st Edition.

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Professional Elective - V

PRODUCTION PLANNING AND CONTROL

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To elucidate the objectives and functions of PPC department for effective running of a production system.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the objectives and functions of PPC.
- appraise different forecasting techniques and estimate the future demand of the product.
- optimize the inventory parameters to minimize the total variable cost.
- determine optimum production schedule.
- illustrate the duties of dispatcher and functions of follow up and outline the role of computers in PPC.
- apply modern management tools for effective planning of a production system.

Course Content

UNIT - I: Introduction

Definition-objectives and functions of production planning and control-elements of production control-organization of production planning and control department-internal organization of PPC department, types of production.

UNIT - II: Forecasting

Forecasting-importance of forecasting-types of forecasting, their uses-general principles of forecasting-forecasting techniques-qualitative methods and quantitative methods.

UNIT - III: Inventory Management

Inventory management-functions of inventories-relevant inventory costs-EOQ models-inventory control systems-P-System and Q-System - ABC analysis-VED analysis

UNIT - IV: Routing, Scheduling and Sequencing

Routing-definition-routing procedure, factors affecting routing procedure, Scheduling-definition-difference with loading, scheduling policies & techniques, standard sequencing methods, Johnson's algorithm (n job two m/c and n job three m/c).

UNIT - V: Dispatching and Follow-up

Dispatching-activities of dispatcher-dispatching procedure, Follow-up-definition-functions-types of follow up, Applications of computer in production planning and control.

UNIT - VI: Modern Production Management Tools

MRP, ERP, overview of JIT, Push/Pull production, Kanban system, Kaizen system, SCM.

Text Books

1. Samuel Eilon "Elements of Production Planning and Control" Collier Macmillan Ltd.
2. R. Panneerselvam "Production and Operations Management", 5th edition, PHI.

Reference Books

1. S.N.Chary " Production and Operations Management" 5th Edition, McGraw Hill
2. Mukhopadhyay,S.K. "Production Planning and Control Text and Cases", PHI.
3. John E. Biegel "Production Control A Quantitative Approach" Prentice Hall.
4. Daniel Sipper and Robert Bulfin "Production Planning, Control and Integration" McGraw Hill.

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Professional Elective - V

POWER PLANT ENGINEERING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the working of various power plants.
- To familiarize with estimation of unit power cost and factors affecting it.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the various conventional energy resources.
- explain the working principles of various power plants used in electric power generation.
- estimate unit power cost under specified conditions.
- list out power plant effluents and their impact on environment.

Course Content

UNIT - I:

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Components, Working of different Circuits.

Coal Handling Systems: Types of fuels, Coal handling, Choice of coal handling equipment.

Air handling system: Induced and forced draught systems.

UNIT - II:

Combustion Process: Methods of Coal firing, Overfeed and Underfeed stoker firing - Principles and types of stoker firing systems, Pulverized fuel firing - Principle, Types of burners and Mills, Fluidized Bed Combustion, Cyclone Burner.

Ash and Dust handling: Types of Ash handling systems, Working principles of various Dust collectors.

Cooling towers: Types of Cooling towers and their working.

UNIT - III:

Gas Turbine Plant: Introduction, Types of Gas Turbine Plants, Layout with auxiliaries, Principles of working of Closed and Open Cycle Gas Turbines. Combined cycle Gas Turbine power plants, Cogeneration.

Diesel power plant: Introduction- Plant layout with auxiliaries, Fuel supply system, Lubrication and Cooling system.

UNIT - IV:

Nuclear Power Station: Nuclear fuel, Nuclear Chain Reaction, Breeding and fertile materials, Nuclear reactor- Reactor Operation.

Classification of Nuclear Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, CANDU Reactor, Homogeneous Reactor, Gas cooled Reactor.

Radiation Hazards and Shielding, Radioactive Waste Disposal.

UNIT - V:

Hydrology: Water power, Hydrological cycle, run off measurement, Hydrographs, drainage area characteristics.

Hydroelectric Power Plant: Classification of Hydroelectric Power Plants, Typical Layouts, Plant auxiliaries, Classification of dams and spill ways.

UNIT - VI:

Power Plant Economics: Capital cost, investment of fixed charges, operating costs, Load curves, and load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor and related exercises.

Environmental Aspects of Power Generation: Effluents from power plants and their impact on environment, Pollutants and Pollution standards, Methods of Pollution control.

Text Books

1. G.D. Rai, "An Introduction to Power Plant Technology", Khanna Publishers, 2004, 3rd Edition.
2. P.K.Nag, "Power Plant Engineering", 2nd Edition, Tata McGraw-Hill Education, 2014, 4th Edition.

Reference Books

1. S.C. Arora and S. Domkundwar "A Course in Power Plant Engineering", Dhanpat Rai & Co. (P) Limited, 2014.
2. R. K. Rajput, "A Text Book of Power Plant Engineering", Laxmi Publications, New Delhi, 2016, 4th Edition.
3. M.M.El-Wakil, "Power Plant Technology", Tata McGraw-Hill Education, Revised 2nd edition.

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Professional Elective - V

THEORY OF ELASTICITY

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of theory of elasticity

Learning Outcomes

Upon successful completion of the course, the students will be able to

- determine stress distribution and strain components for simple and symmetric problems
- analyze three dimensional problems using equilibrium and compatibility equations
- determine stresses induced in beams of different cross sections
- apply concepts of plasticity to determine the shear stresses and strain energy.

Course Content

UNIT - I:

Elasticity: Introduction: Elasticity - notation for forces and stress - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - differential equations of equilibrium - boundary conditions – Strain Displacement Relations - compatibility equations - stress function

UNIT - II:

Two dimensional problems in rectangular coordinates - solution by polynomials - SaintVenants principle - determination of displacements - bending of simple beams – Simple Supported and Cantilever Beam.

UNIT - III:

Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions Edge Dislocation - general solution of two-dimensional problem in polar coordinates - application to Plates with Circular Holes – Rotating Disk.

UNIT - IV:

Analysis of Stress and Strain in Three Dimensions: Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses Stress Invariants - max shear stresses Stress Tensor – Strain Tensor- Homogeneous deformation - principal axes of strain-rotation. **General theorems:** Differential equations of equilibrium - conditions of compatibility - determination of displacement - uniqueness of solution - reciprocal theorem Strain Energy.

UNIT - V:

Bending of Prismatic Bars: Stress function - bending of cantilever beam - beam of rectangular cross-section - beams of circular cross-section.

UNIT - VI:

Torsion of Circular Shafts - Torsion of Straight Prismatic Bars – Saint Venants Method - torsion of prismatic bars - bars with elliptical cross sections - membrane analogy - - solution of torsional problems by energy method - torsion of shafts, tubes , bars etc.Torsion of Rolled Profile Sections.

Text Books

1. S.P. Timoshenko & J.K Goodier , "Theory of Elasticity", McGraw-Hill,3rd Edition.
2. "Applied Elasticity" by C.T. Wang.

Reference Books

1. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
2. E.P. Unksov ,"An Engineering Theory of Plasticity", Butterworths scientific publications,1961.
3. Hoffman and Sacks , "Theory of Plasticity" , McGraw-Hill, New York, 1953.

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Professional Elective - VI

RAPID PROTOTYPING

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with rapid prototype tools and techniques for design and Manufacturing.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- assess the need of RPT in Product development.
- use appropriate RT Software for development of Prototype model.
- judge the correct RP Process for Product/Prototype development.
- predict the technical challenges in 3D printing.
- list the applications of RPT.

Course Content

UNIT - I:

Introduction to Rapid Prototyping: Introduction to prototyping, traditional prototyping Vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

UNIT - II:

RP Software: Need for RP software, MIMICS, magics, surgiGuide, 3D-doctor, simplant, velocity2, voxim, solidView, 3Dview, etc., software.

Software Issues of RP: Preparation of CAD models, problems with STI, files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT - III:

Photopolymerization RP Processes: Sterolighography (SL), SL resin curing process, SL scan patterns, microstereolithography, applications of photopolymerization processes.

Powder Bed Fusion RP Processes : Selective laser sintering (SLS), powder fusion mechanism and powder handling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes.

UNIT - IV:

Extrusion-Based RP Systems: Fused deposition modelling (FDM), principles, plotting and path control, applications of extrusion-based processes.

Printing RP Processes: 3D printing (3DP), research achievements in printing deposition, technical challenges in printing, printing process modeling, applications of printing processes.

UNIT - V:

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications.

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), processing – structure - properties, relationships, benefits and drawbacks.

UNIT - VI:

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, classification of rapid tooling, direct and indirect tooling methods, soft and hard tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, part building errors in SLA, SLS, etc.,

RP Applications: Design, engineering analysis and planning applications, rapid tooling, reverse engineering, medical applications of RP.

Text Books:

1. Chua Chee Kai., Leong KahFai., Chu Sing Lim, "Rapid Prototyping: Principles and Applications in Manufacturing", World Scientific

Reference Books

1. Ian Gibsn., David W Rosen., Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Pham, D.T, Dimov, S.S, Rapid Manufacturing, Springer, 2001.

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Professional Elective - VI

GAS DYNAMICS AND JET PROPULSION

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To analyze and solve basic problems of Subsonic and Supersonic flows of compressible fluids with Friction and Heat transfer.
- To estimate the thrust and specific impulse of a propeller engine from fluid and thermodynamic principles.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the physics involved in the equations of compressible one dimensional flows
- analyse one dimensional flows including shock wave with heat addition and friction.
- analyse the effect of shock waves on compressible flows
- classify propulsion engines and describe their working
- analyze the working principle of Jet and rocket engines and draw its performance characteristics.

Course Content

UNIT - I:

Definitions and basic Relations: Energy equation for flow processes, stagnation-pressure, density, temperature, velocity, Mach number, Critical Mach number, Mach Cone, Mach angle, effect of Mach number on compressibility.

Basic Equation of compressible Flow: Energy and Momentum equations for compressible fluid flow, type of waves, Wave propagation, Velocity of Sound, Subsonic and Supersonic Flow.

UNIT - II:

Steady -one dimensional Flow: Fundamental Equations, Discharge from a Reservoir, Stream tube, Area–Velocity Relation, De-laval Nozzle, diffusers, dynamic head, Measurement in Compressible Flow, Pressure Coefficient.

UNIT - III:

Normal Shock Waves: Equation of Motion for Normal Shock Waves, Normal Shock Relations, total pressure across the shock wave, determination of Mach number of supersonic flows

Oblique Shock Waves: Nature of flow through Oblique shock wave, Relations, Prandtl's equation, variation of flow parameters, Oblique Shock Relations from the normal shock equation,

UNIT - IV:

Flow with Friction: Flow in constant area duct with friction, Fanno line, Fanno flow equations, variation of flow properties,.

Flow with Heat Transfer: Flow with heating or cooling in ducts, Rayleigh line, Fundamental Equations, Rayleigh flow relations, variation of flow properties.

UNIT - V:

Propulsion: Air craft propulsion- types of jet engines- energy flow through jet engines, thrust, thrust power and propulsive efficiency, turbojet components- diffuser, compressor, combustion chamber, turbines, exhaust systems.

UNIT - VI:

Performance of Jet Propulsion Engines: Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines.

Rocket propulsion- types of rocket engines, solid and liquid propellant rockets- hybrid propellant rockets, nuclear propellant rockets, propellants, analysis of rocket propulsion.

Text Books

1. S.M. Yahya, "Fundamentals of compressible flow", New Age international publications, 3rd edition.
2. E Rathakrishnan, "Gas Dynamics", Prentice Hall of India, 6th edition.

Reference Books

1. Bird G A, "Molecular Gas Dynamics and the Direct Simulation of Gas Flows", Vol-I, Oxford University, Clarendon Press.
2. Zucrwo M.J. and Hoffman J.D. "Gas Dynamics", Vol-I & Vol-II, John Wiley and Sons Inc.
3. Yahya. S.M., "Fundamental of compressible flow with Aircraft and Rocket Propulson" New Age International (p) Ltd., New Delhi, 4th edition.

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Professional Elective - VI

AUTOMATION IN MANUFACTURING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce various stratagies of automation in manufacturing.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain automation strategies and transport mechanisms in automated flow lines.
- analyze the automated flow lines with and without buffer storage.
- choose appropriate material handling system for a given application.
- explain the principles of AS/RS and carousel storage systems.
- describe the ACO and ACC strategies to reduce the machine time.
- demonstrate the automated inspection methods.

Course Content

UNIT - I: Introduction

Production system – Automation in Production System – Elements of automated system – Levels of automation - Types of Automation – Auomation principles and strategies. Automated Flow Lines: Configurations of AFL - Methods of part transport - Transfer mechanism - Buffer storage – System design considerations

UNIT - II: Analysis of Automated Flow Lines

General terminology and analysis of transfer Lines without buffer storage – upperbound approach and lowerbound approach - analysis of automated flow lines with buffer storage – analysis of two stage transfer line – analysis of more than two stages - partial automation – analysis – cost calculations.

UNIT - III: Automated Material Handling

Introduction – Design considerations in material handling - Types of equipment - Material transport equipment – AGVS – Conveyors – Hoists and cranes - analysis of material transport systems – vehicle based systems – conveyor analysis.

UNIT - IV: Automated Storage Systems

Automated storage and retrieval systems – Reasons for automating storage operations – Types of AS/RS – Applications of AS/RS – Carousel storage systems – Analysis of storage systems.

UNIT - V: Adaptive Control Systems

Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in Machining operations. Use of various parameters such as cutting force, temperature, vibration and acoustic emission.

UNIT - VI: Automated Inspection

Fundamentals of Inspection – Types of inspection – Inspection procedure – Automated inspection – Off line and On-line inspection - Fundamentals types of inspection methods and equipment – CMM - Machine vision.

Text Books

1. Groover.M.P,"Automation, Production Systems and Computer Integrated Manufacturing", Pearson Publications.

Reference Books

1. Yoram Coren, "Computer Control of Manufacturing Systems", Tata McGraw Hill.
2. P. Radhakrishnan & N.Subhrammanyan, "CAD/CAM/CIM", Digital Design Publications.
3. W. Buekinsham, "Automation", PHI Publications, 3rd edition.
4. D.Y Pham & S.S Dimav Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer Publication.

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Professional Elective - VI

NON DESTRUCTIVE TECHNIQUES

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of various NDE techniques to identify the defect in a mechanical elements.

Course Outcomes

Upon successful completion of the course, the students will be able to

- choose a suitable non destructive method to find the defect in the given mechanical components using radiography, ultrasonic test, magnetic particle test etc.,

Course Content

UNIT - I: Introduction to Non-Destructive Testing

Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography

UNIT - II: Ultrasonics Test

Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III: Liquid Penetrant Test

Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing

UNIT - IV: Magnetic Particle Test

Magnetic Materials, Magnetization of Materials, Demagnetization of Materials,Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT - V: Eddy Current Test

Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing

UNIT - VI: Industrial Applications of NDE

Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Text Books

1. Non-Destructive Test and Evaluation of Materials, J Prasad, GCK Nair, TMH Publishers.
2. Ultrasonic Testing by Krautkramer and Krautkramer.
3. Non-Destructive Testing, Warress, JMc Gonmade.

References Books

1. Ultrasonic inspection training for NDT: E. A. Gingel, Prometheus Press.
2. ASTM Standards, Vol 3.01, Metals and alloys.
3. Non-Destructive, Hand Book – R. Hamchand.

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Professional Elective - I

CAD FOR VLSI

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To make the students familiarize with the VLSI design methodologies, optimization of combinational circuits, layout, floorplan, and simulation and synthesis techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand various methodologies for the design of VLSI systems.
- optimize combinational circuits.
- develop algorithms for the layout optimization.
- size floor plan and solve routing problems.
- analyze different simulation and synthesis techniques.

Course Content

UNIT - I: VLSI Design Methodologies

The VLSI design problem, design domains, actions, methods, and technologies; algorithmic and system design, structural and logic design, transistor-level design, layout design, verification methods, design management tools.

UNIT - II: Combinatorial Optimization

Unit-size placement problem, backtracking and branch-and-bound, dynamic programming, integer linear programming, local search, simulated annealing, tabu search, genetic algorithms.

UNIT - III: Layout Optimization

Design rules, symbolic layout, problem formulation, algorithms for constraint-graph compaction, placement and partitioning-circuit representation, wire length estimation, types of placement problem, placement algorithms, partitioning.

UNIT - IV: Floor planning and Routing

Floor planning-concepts, shape functions and floorplan sizing, routing-types of local routing problems, area routing, channel routing, introduction to global routing, algorithms for global routing.

UNIT - V: Simulation

VLSI simulation, Gate-level modelling and simulation, switch-level modelling and simulation.

UNIT - VI: Logic Synthesis

Introduction to combinational logic synthesis, binary-decision diagrams, two-level logic synthesis, High-level synthesis-hardware models, internal representation of input algorithm, allocation, assignment, and scheduling, scheduling algorithms.

Text Book

1. S.H.Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

Reference Books

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific 1999.
3. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.
4. Prof. V. Kamakoti and Prof.Shankar Balachandran, "CAD for VLSI Design I", NPTEL Web Course, IIT Madras.
5. Prof. V. Kamakoti and Prof.Shankar Balachandran, "CAD for VLSI Design II", NPTEL Web Course, IIT Madras.
6. Coursera, "VLSI CAD Part I : Logic", Online course. (https://www.coursera.org/learn/vlsi-cad-logic)
7. Coursera, "VLSI CAD Part II : Layout", Online course. (https://www.coursera.org/learn/vlsi-cad-layout)

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Professional Elective - I

COMPUTER ORGANIZATION

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarized with the concepts of computer components, instruction set, addressing modes and computer arithmetic.
- To impart the implementation of control unit, memory organization and various I/O data transfer schemes.

Course Outcomes

Upon successful completion of the course, the students will be able to

- learn the basic structure and operations performed by the components of a digital computer.
- know the concepts of micro-programming, micro code sequencing and pipelining techniques.
- differentiate the hierarchical memory system including cache, virtual memories and instruction level parallelism.

Course Content

UNIT - I: Computer System

Computer components, computer function, interconnection structures, bus interconnection, integer representation, floating point representation.

UNIT - II: Central Processing Unit

Process Structure and Functions - Processor organization, register organization, instruction cycle, instruction pipelining.

Instruction Sets: Characteristics and Addressing Modes – Machine instruction characteristics, types of operands and operations, addressing, instruction format.

UNIT - III: Control Unit and Micro Programmed Control

Micro-operations, control of the processor, hardwired implementation, micro programmed control – basic concepts, microinstruction sequencing, microinstruction execution.

UNIT - IV: Computer Arithmetic

Addition and subtraction, multiplication algorithms, division algorithms, floating point arithmetic operations.

UNIT - V: Memory Organization

Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory, memory management hardware.

UNIT - VI: Input Output Organization & Introduction to ARM

Peripheral devices, input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access.

Text Books

1. William Stallings, "Computer Organization and Architecture", Pearson Publications, 8th edition. (Unit I-III & ARM)
2. M. Morris Mano, "Computer System Architecture", Pearson Publications, 3rd edition. (Unit IV – VI)

Reference Books

1. Hamachar, Vranesic, "Computer Organization", 5th edition, TMH.
2. V. Rajaraman, T. Radhakrishnan, "Computer Organization and Architecture", PHI Learning, 2007.
3. P.Pal Chaudhuri, "Computer Organization and Design", 3rd Edition, PHI Learning.

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Professional Elective - I

COMPUTER AND COMMUNICATION NETWORKS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce principles and functionality of layered network
- To familiarize with the ethical, legal, and social issues related to computer networking.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the topology and architecture of a computer network.
- differentiate the OSI and TCP reference models.
- apply protocols to different layers of a network hierarchy.
- understand different datalink protocols.
- identify the routing algorithm for given user application.
- understand the applications of computer networks.

Course Content

UNIT - I: Network Models

LAN, MAN and WAN, network topologies, protocols and standards, The OSI/ ISO reference model- layers in the OSI model, TCP/IP protocol suite, addressing.

Switching - circuit-switched networks, datagram networks, virtual-circuit networks.

UNIT - II: Data Link Control

Framing, flow and error control, error detection and correction, Stop and wait protocol, Go-back N, selective repeat, HDLC protocols.

UNIT - III: MAC Sub Layer

Random access protocols, IEEE 802.3-MAC sub layer, physical layer. IEEE 802.11 and Bluetooth.

UNIT - IV: Network Routing Algorithms

Routing algorithms- shortest path, flooding, distance vector, link state routing. IPv4 addresses-address space, notation; IPV4, IPV6, transition from IPv4 to IPv6, mapping logical to physical address, mapping physical to logical address.

UNIT - V: Congestion Control and QoS

Congestion control- open loop and closed loop congestion control; Quality of Service, techniques to improve QoS;

Transport Layer- UDP, TCP- services, features, segment, connection management, flow control, error control, and congestion control.

UNIT - VI: Application Layer

Domain name system- domain name space, distribution of name space, DNS in the internet, resolution; Electronic mail- architecture, user agent, message transfer agent, message access agent; WWW and HTTP.

Text Books

1. Behrouz. A. Forouzan, "Data Communication and Networking", 4th Edition, Tata McGraw-hill, New Delhi, 2006.
2. Andrew .S. Tanenbaum, "Computer Networks", 4th Edition PHI Learning Private Ltd, New Delhi, 2008.

Reference Books

1. William Stallings, "High Speed Networks and Internets", 2nd Edition, Pearson Education Asia, New Delhi, 2002.
2. Houston. H. Carr and Charles. A. Snyder, "Data Communications and Network security", Tata McGraw-hill, New Delhi, 2007
3. Peterson. L and Davie. B, "Computer Networks", Morgan Kauffmann, 2008.

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Professional Elective - I

BIOMEDICAL ENGINEERING

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the basics of biological concepts and relate it to engineering.
- To familiarize with physiology of cardio-vascular system, respiratory system and the elements of Patient Care Monitoring.
- To impart the knowledge on the patient monitoring displays, diagnosis & techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- know the concept of bio-medical engineering, evolution, age, development, advancements and applications.
- get awareness on noval theory related to human body and various components.
- analyze the operation of measuring the cardio-vascular system by knowing its inner organization, sensor and transducer theory & plethysmographical concepts.
- learn the principles of respiration and respiratory therapy equipment.
- understand the fundamental principles & techniques of diagnosys and bio-telemetry, monitors, recorders.

Course Content

UNIT - I: Introduction to Bio-Medical Instrumentation

Man instrumentation system-introduction & components, physiological system of the body, sources of bio-electric potentials, resting & action potentials,Electro-Cardiogram(ECG),Electro-Encephalogram(EEG), Electro Myogram (EMG),envoked responses.

UNIT - II: Electrodes & Transducers

Bio-potential electrodes, basic transducers-transduction principles, biochemical transducers, active & passive transducers, transducers of bio-medical applications, pulse sensors, respiration sensors.

UNIT - III: Cardio-Vascular System & Respiratory System Measurements

The heart & cardiovascular system, Electro-Cardiography, blood pressure measurement, measurement of blood flow & cardiac output, the physiology of the respiratory system, tests & instrumentation for the mechanics of breathing, respiratory therapy equipment.

UNIT - IV: Patient Care & Monitoring

Elements of intensive care monitoring, patient monitoring displays, diagnosis, calibration & repair ability of patient monitoring equipment, organization of the hospital for patient care monitoring, pace-makers, defibrillators.

UNIT - V: Diagnostic Techniques & Bio-Telemetry

Principles of ultrasonic measurement, Ultrasonic Imaging, Ultrasonic Diagnosis X-Ray & Radio-Isotope Instrumentations CAT Scan, Emission Computerized Tomography, MRI, Introduction & components of bio-telemetry system.

UNIT - VI: Monitors, Recorders & Shocking Hazards

Monitors, recorders, shock hazards & prevention, physiological effects & electrical equipment, methods of accident prevention, isolated power distribution system.

Text Books

1. Onkar N. Pandey, Rakesh kumar, "Bio-Medical Electronics and Instrumentation", S. K. Kataria & Sons, 2007.
2. Cromewell, Wiebell, P.feiffer, "Biomedical instrumentation and measurements", Prentice-Hall, 1973.

Reference Books

1. Joseph J.Carr, John M.Brown, "Introduction to Bio-Medical Equipment Technology", Pearson Publications, 4th Edition.
2. Khandapur, "Handbook of Bio-Medical Instrumentation", TMH, 2nd Edition.

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Optional Elective - II

DATA WAREHOUSING AND DATA MINING

III Year – I Semester

Lecture : -		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce concepts of Data mining, data pre-processing and Data warehousing.
- To familiarize with concepts of association rule mining, classification, clustering techniques and algorithms.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline different types of databases used in data mining.
- apply pre-processing methods on raw data to make it ready for mining.
- illustrate the major concepts and operations of multi dimensional data models.
- analyze the performance of association rules mining algorithms for finding frequent item sets from the large databases.
- simplify the data classification procedure by selecting appropriate classification methods / algorithms.
- classify various clustering methods and algorithms on data sets to create appropriate clusters.

Course Content

UNIT - I: Introduction

Motivation and importance of data mining, types of data to be mined: relational databases, data warehouses, transactional databases, advanced database systems, data mining functionalities.

UNIT - II: Data Pre-processing

Major tasks in data pre-processing, data cleaning: missing values, noisy data; data reduction : overview of data reduction strategies, principal components analysis, attribute subset selection, histograms, sampling; data transformation: data transformation strategies overview, data transformation by normalization.

UNIT - III: Data Warehousing and Online Analytical Processing

Data warehouse: Basic concepts, OLAP vs. OLTP; Data warehousing: A multi-tiered architecture; Data warehouse modelling: Data cube and OLAP; Data cube:

A multidimensional data model, star, snowflake and fact constellation schemas for multidimensional data models, the role of concept hierarchies, typical OLAP operations.

UNIT - IV: Mining Frequent Patterns, Associations, and Correlations

Basic concepts, frequent item sets, closed item sets and association rules, frequent item set mining methods: apriori algorithm, generations association rules form frequent item sets, a pattern- growth approach for mining frequent item sets.

UNIT - V: Classification

Basic concepts, what is classification, general approach to classification, decision tree induction, attribute selection measures: information gain, Bayes classification methods: Bayes theorem, Naive Bayesian classification.

UNIT - VI: Cluster Analysis

Introduction, overview of basic clustering methods, partitioning methods: k-means, k-medoids; hierarchical methods: agglomerative versus divisive hierarchical clustering, density based method : DBSCAN.

Text Book

1. Jiawei Han, Micheline Kamber & Jian pei, "Data Mining Concepts and Techniques", 3rd edition, Morgan Kaufmann Publisher an imprint of Elsevier,.

Reference books

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar "Introduction to Data Mining", 1st edition, Pearson,.
2. Margaret H Dunham, "Data Mining Introductory and Advanced Topics", 1st edition, Pearson Education.

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Optional Elective - II

MECHATRONICS

III Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart knowledge on design of complex engineering systems using sensors, actuators, controllers.
- To familiarize with the intelligent systems used in Mechatronics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the elements of Mechatronic Systems
- select suitable sensors, actuators and controllers to meet specific requirements
- draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristic and membership functions respectively.

Course Content

UNIT - I:

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach, advantages and disadvantages of Mechatronics systems.

UNIT - II:

Sensors and Transducers: Types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature, light sensors and micro sensors.

UNIT - III:

Review of fundamentals of electronics. Data conversion devices, signal processing devices, relays, contactors and timers. Microprocessors, microcontrollers and PLCs.

UNIT - IV:

Actuators: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems. Description of PID Controllers.

UNIT - V:

Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits.

Pneumatics: Production, distribution and conditioning of compressed air, system components and graphic representations.

Electro hydraulic, Electro pneumatic and hydro pneumatic servo systems.

UNIT - VI:

Fuzzy Set Theory: Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of membership function, Fuzzy extension principle, Fuzzy Systems: fuzzification and defuzzification and fuzzy controllers.

Text Books

1. Bolton. W, "Mechatronics", Addison Wesley, 4th Edition, New Delhi.
2. Dan Nesulescu, "Mechatronics", 3rd Edition, Pearson Education
3. Michael B. Histand and David G. Aliatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill

Reference Books

1. Devadas Shetty, Richard A Kolk, "Mechatronics System Design",
2. B.P. Singh (2002), "Advanced Microprocessor and Microcontrollers" New Age International Publisher.
3. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
4. H.J.Zimmermann, Fuzzy Set Theory and Its Applications, 2nd Ed., Kluwer Academic Publishers, 1996.
5. S.N. Sivanandam and S.N.Deepa, "Principles of Soft Computing" Second Edition, Wiley India Pvt.Ltd.

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Optional Elective - II

INTRODUCTION TO MEMS

III Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce lithography principles, mechanical sensors and actuators.
- To make it known the thermal sensors and actuators, magnetic sensors and actuators.
- To present formally micro fluidic systems and chemical and bio medical micro systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- define MEMS, lithography methods, sensors and actuators.
- describe the principles of MOEMS technology and its applications.
- elucidate different magnetic sensing and detection for MEMS.
- apply sensing principles and mechanisms the chemical and bio medical micro systems.

Course Content

UNIT - I: Introduction

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

Mechanical Sensors and Actuators: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT - II: Thermal Sensors and Actuators

Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT - III: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT - IV: Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT - V: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, optoelectro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

UNIT - VI: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

Text Book

1. Nitaigour Premchand Mahalik "MEMS", TMH Publishing co.

Reference Books

1. Chang Liu "Foundation of MEMS", Prentice Hall Ltd.
2. Sergey Edwrd Lyshevski "MEMS and NEMS", CRC Press, Indian Edition.
3. Tai-Ran Hsu "MEMS and Micro Systems: Design and Manufacture", TMH Publishers.
4. Richard A Layton, Thomas M Adams "Introductory MEMS", Springer International Publishers.

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Professional Elective - II

ANALOG IC DESIGN

III Year – II Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the concepts and design of analog integrated circuits.
- To expose the students to various circuits like amplifiers, switched capacitor circuits, current mirrors, PLLs used in analog ICs.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- Apply the knowledge of Mathematics and semiconductor theory in analyzing and designing of analog integrated circuits
- Demonstrate the knowledge and understanding of various current mirrors and switched capacitor circuits
- Describe and determine the effect of feedback on the stability of amplifier circuits.
- Select an appropriate A/D and D/A converter to meet specified performance requirements.

Course Content

UNIT - I:

Basic Mos Device Physics: Second order effects, MOS Device Models

Single Stage Amplifiers: Basic concepts, MOS amplifiers-Common Source stage, source follower, common gate stage, Cascode stage- folded cascode.

UNIT - II:

Differential Amplifiers: single ended and differential amplifiers, Basic differential pair, Common mode response, Differential pair with MOS loads.

Current Mirrors: Simple CMOS current mirror with common source amplifier, source degenerated current mirrors, High output impedance current, mirrors, Bipolar current mirrors. Cascade, Wilson, Wildar current mirrors.

UNIT - III:

Operational Amplifiers: one – stage op-amps, two stage op-amps-gains boosting stage comparison, I/P range limitations, slew rate.

Feed Back and Stability: Feedback topologies, multi pole systems, phase margin, frequency compensation.

UNIT - IV:

Switched Capacitors Circuits: Sampling switches, Switched-Capacitor Amplifiers, Switched –Capacitor Integrator.

UNIT - V:

Phased Locked Loop Design: Basic loop architecture, derivation for lock range and capture range. Charge pump PLL, small signal analysis of charge pump PLL.

UNIT - VI:

Nyquist Rate D/A Converters: Decoder based converter resistor storing converters folded resister string converter – Binary scale converters – Binary weighted resistor converters – Reduced resistance ratio ladders – R-2R based converters – Thermometer code current mode D/A converters.

Nyquist Rate A/D Converters: Integrating converters – successive approximation converters. DAC based successive approximation – flash converters time interleaved A/D converters.

Text Books

1. David A Johns, Ken Martin, "Analog Integrated circuit Design", John Wiley & Sons (Unit: VI).
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH, 2001 (Units: I to V)

Reference Books

1. Gray, Hurst Lewis, Meyer, "Analysis and design of Analog Integrated Circuits", John Wiley & Sons, 2000.
2. Franco Maloberti, "Analog Design for CMOS VLSI Systems", Kluwer Academic Publishers, 2001.

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Professional Elective - II

NANO ELECTRONICS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To understand the limitations of silicon electronics, progress of nanoelectronics and basic concepts of nano electronics.
- To know the fabrication techniques and scaling of nanodevices.
- To study the significance of tunneling effect in nanoelectronic devices and the concepts of Coulomb blockade.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain various aspects of nano electronics.
- explore the fabrication techniques used for nanodevices.
- identify the importance of scaling.
- list of various applications of tunneling.
- demonstrate the concepts of coulomb blockade and electron transport mechanisms.

Course Content

UNIT - I: Toward the Nanoscale

Scientific opportunities, technological motivations, improving materials on the nanoscale, fabrication techniques on the nanoscale, improvement in characterization methods for the nanoscale, new principles of device operation at the nanoscale, nanotechnology for optoelectronics.

UNIT - II: Growth and Fabrication of Nanostructures

Bulk crystal and heterostructure growth, nanolithography, etching, and other means of nanostructures and nanodevices, spontaneous formation and ordering of nanostructures, clusters and nanocrystals, methods of nanotube growth- chemical and biological methods for nanoscale fabrication, fabrication of nano-electromechanical systems.

UNIT - III: Nanoscale MOSFETs

Introduction, MOSFET scaling, short- channel effects, multiple-gate MOSFETs, FinFETs.

UNIT - IV: Tunnel Junctions and Applictions of Tunneling

Tunneling through a potential barrier, potential energy profiles for material interfaces, Application of tunneling.

UNIT - V: Coulomb Blockade

Coulomb blockade in a nanocapacitor, tunnel junction excited by a current source, coulomb blockade in a Quantum Dot Circuit.

UNIT - VI: Nanostructure Devices

Resonant tunneling diode, single electron transistors, carbon nanotube transistor, transport of spin and spintronics.

Text Books

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, and Michael A. Stroscio, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications", Cambridge University Press, 2008 (UNITS: I & II).
2. George W.Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009 (UNITS: IV - VI).

Reference Books

1. Anantha Chandrakasan, "FinFETs and Other Multi-Gate Transistors", Springer, 2008 (UNIT: III).
2. Jerry G. Fossum and Vishal P. Trivedi, "Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs", Cambridge University Press, 1st Edition, 2013 (UNIT: III) .

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Professional Elective - II

SMART ANTENNAS

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce beamforming concepts.
- To impart angle of arrival estimation techniques

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply different windowing techniques to obtain weights for desired antenna pattern.
- make use of random variables for pre-processing of the signals.
- differentiate the performance of general antenna and smart antenna for spatial processing of the signal.
- conceptualize adaptive beamforming.
- understand the concept of angle of arrival algorithms for beamforming.
- test the received signal performance with different algorithms and can choose the suitable algorithm for the given application.

Course Content

UNIT - I: Array Weighting Fundamentals

Array weighting-Blackman weights, Hamming weights, Gaussian weights, Kaiser Bessel weights, fixed beam arrays, fixed sidelobe cancelling,

UNIT - II: Principles of Random Variables and Process

Definition of random variables, probability density functions, expectation and moments, common probability density functions, autocorrelation and power spectral density, correlation matrix.

UNIT - III: Smart Antennas

Introduction, the historical development of smart antennas, early forms of spatial processing, fixed weight beamforming basics: maximum S/I ratio, minimum mean square error, maximum likelihood, and minimum variance. diversity, sectorization.

UNIT - IV: Adaptive Beam Forming

Least mean squares (LMS), sample matrix inversion (SMI), recursive least squares (RLS), constant modulus (CM)

UNIT - V: Angle of Arrival Estimation

Fundamentals of matrix algebra, array correlation matrix, non-blind beamforming, blind beam forming, angle of arrival estimation methods: Bartlett AOA estimate, Capon AOA estimate.

UNIT - VI: Smart Antenna Performance

Beamforming array performance, receive diversity performance, combined diversity and beamforming performance, choosing a spatial processing technique.

Text Books

1. Frank B. Gross "Smart Antennas for Wireless Communications with MATLAB", McGraw –Hill, 2005.
2. Pieter van Rooyen, Michiel Lotter and Danie van Wyk "Space Time Processing for CDMA Mobile Communications" Kluwer Academic Publishers, 2000.

Reference Books

1. Tapan K. Sarkar, Michel C. Wicks, M.S. Palma and Robert J. Bonnea "Smart Antennas", John Wiley & Sons – 2003.
2. S.Chandran "Adaptive Antenna Arrays: Trends and Applications" Springer,2004.
3. A Paulraj, Rohit nabar and Dhananjay Gore "Introduction to Space Time Wireless Communications", Cambridge University Press, 2003.

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Professional Elective - II

CODING THEORY

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of information theory.
- To familiarize basic concepts of linear block codes and convolution codes.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- develop mathematical models for practical communication channels and analyze information carrying capacity.
- understand source coding mechanism.
- analyze linear block codes and investigate the relationship between minimum distance and error correction/detection capabilities
- analyze encoder and efficient decoder algorithms for convolutional codes.
- design and implement channel encoder and decoder in hardware/ software to meet the required error performance in present day communication applications.

Course Content

UNIT - I: Information Theory

Discrete messages, concept of amount of information and its properties, average information, Entropy and its properties,information rate, mutual information and its properties.

UNIT - II: Source Coding

Shannon's theorem, Shanon-Fano coding, Huffman coding, efficiency calculations, channel capacity of a Gaussian channel, bandwidth –S/N trade off.

UNIT - III: Linear Block Codes

Introduction, matrix description of linear block codes, error detection and error correction capabilities of linear block codes, hamming codes.

UNIT - IV: Cyclic Codes

Binary cyclic codes, algebraic structure, encoding, syndrome calculation, and table look-up decoding using standard array.

UNIT-V: BCH and Reed Solomon Codes

BCH codes- decoding of BCH codes,the Berlekamp- Massey decoding algorithm. Reed Solomon codes- generalized Reed Solomon codes, MDS codes.

UNIT - VI: Convolution Codes

Introduction, encoding of convolution codes, time domain approach, transform domain approach, graphical approach: state, tree and trellis diagram,decoding using Viterbi algorithm and sequential decoding, advantages of convolution codes over block codes.

Text Books

1. W.C. Huffman and Vera Pless, "Fundamentals of Error correcting codes", Cambridge University Press, 2003.
2. Sam Shanmugam "Digital and Analog Communication Systems", John Wiley, 2005.

Reference Books

1. Simon Haykin "Communication Systems", John Wiley, 2005
2. Sklar, "Digital Communication", Pearson Education.
3. Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", 2nd Edition Prentice Hall Inc, 2004.
4. R.E. Blahut, "Theory and Practice of Error Control Coding", McGraw Hill 1983.

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Optional Elective - V

BIG DATA ANALYTICS

III Year – II Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the architectural concepts of Hadoop and introducing map reduce paradigm.
- To disseminate knowledge on how to summarize, query, and analyze data with Hive.
- To familiarize with business decisions and create competitive advantage with Big Data analytics.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- summarize the importance of Big Data and its problems (storage and analysis).
- outline the building blocks of hadoop and anatomy of file read and write.
- analyze data with hadoop MapReduce.
- generalize how MapReduce works when running a job.
- choose best programming tools for solving real world and industrial problems.

Course Content

UNIT - I: Introduction to Big Data

What is Big Data, characteristics of Big Data - The four Vs Why Big Data is important, data, data storage and analysis, comparison with other systems, brief history of Hadoop, apache Hadoop and the Hadoop eco system.

UNIT - II: The Hadoop Distributed File System

The design of Hadoop Distributed File System (HDFS), architecture, building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), basic file system operations, anatomy of a file read, anatomy of a file write.

UNIT - III: Introduction to Map Reduce

A weather dataset, analyzing weather data with UNIX tools, analyzing data with Hadoop, Map and reduce, java map reduce, the old and new Java map reduce APIs, data flow, combiner functions, running a distributed map reduce job.

UNIT - IV: How Map Reduce works

Anatomy of a map reduce job run : job submission, job initialization, task assignment, task execution, progress and status updates, job completion; shuffle and sort : the map side, the reduce side.

UNIT - V: Pig

Admiring the Pig architecture, going with the Pig Latin Application Flow, working through the ABCs of Pig Latin, evaluating local and distributed modes of running Pig Scripts, checking out the Pig script interfaces, scripting with Pig Latin.

UNIT - VI: Hive

Getting started with apache hive, examining the hive clients, working with hive data types, creating and managing databases and tables with hive, seeing how the hive data manipulation language works, querying and analyzing data.

Text Books

1. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'Reilly.
2. Chuck Lam, "Hadoop in Action", 1st edition ,Manning Publications.
3. Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss, "Hadoop for Dummies", 1st edition, John Wiley ans Sons.

Reference Books

1. Dirk deRoos, Chris eaton, George Lapis, Paul Zikopoulos, Tom Deutsch "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st Edition, TMH, 2012.
2. Srinath Perera, Thilina Gunarathne, "Hadoop Map Reduce Cookbook", Packt Publishing.

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Optional Elective - V

COGNITIVE RADIO NETWORKS

III Year – II Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce software defined radio evolution and cognitive radio.
- To make it known the characteristics of spectrum, regulation history and issues.
- To present formally communication techniques and cognitive radio network theory.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand concepts of software defined radio.
- define physical characteristics of spectrum and regulatory challenges.
- describe the spectrum sensing and its implications.
- differentiate different spectrum sharing schemes.
- elucidate different relay communication techniques exist.
- apply the entropy concepts to find the limits on the cognitive radio networks.

Course Content

UNIT - I : Introduction

Software defined radio, evolution of software-defined radio, cognitive radio, evolution of cognitive radio, key applications, interoperability, dynamic spectrum access

UNIT - II : Radio Frequency Spectrum and Regulation

Spectrum: physical characteristics of spectrum and implications, regulatory history and successes, emerging regulatory challenges and actions, regulatory issues of cognitive access, spectrum measurements and usage, applications for spectrum occupancy data,

UNIT - III: Spectrum Sensing and Identification

Primary signal detection: energy detector, cyclo-stationary feature detector, matched filter, cooperative sensing, definition and implications of spectrum opportunity, spectrum opportunity detection, fundamental trade-offs: performance versus constraint, mac layer performance measures, global interference model, local interference model, fundamental trade-offs: sensing accuracy versus sensing overhead.

UNIT - IV: Spectrum Access and Sharing

Unlicensed spectrum sharing, licensed spectrum sharing, secondary spectrum access, non-real-time SSA, real-time SSA, negotiated access, possibility of quality of service provisioning in a shared band, opportunistic access, overlay approach, underlay approach

UNIT - V: User Cooperative Communications

User cooperation and cognitive systems, relay channels: general three-node relay channel, wireless relay channel, user cooperation in wireless networks: two-user cooperative network, cooperative wireless network, multihop relay channel

UNIT - VI: Information Theoretical Limits on CR Networks

Types of cognitive behavior, interference-avoiding behavior: spectrum interweave, interference-controlled behavior: spectrum underlay, underlay in small networks: achievable rates, underlay in large networks: scaling laws, interference-mitigating behavior: spectrum overlay, opportunistic interference cancellation, asymmetrically cooperating cognitive radio channels.

Text Books

1. Alexander M. Wyglinski, Maziar Nekoyee, and Y. Thomas Hou, " Cognitive Radio Communications and Networks – Principles and Practice", Elsevier Inc., 2010.

References Books

1. Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons, Ltd., 2009.
2. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
3. Joseph Mitola III,"Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.

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Optional Elective - V

CRYPTOGRAPHY AND NETWORK SECURITY

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce different types of security attacks and Services.
- To expose different cryptographic techniques and Algorithms.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe security attacks and services over networks.
- differentiate symmetric and asymmetric encryption techniques.
- apply integrity checking and authentication techniques.
- compare E-mail security and IP level security.
- use firewalls and intrusion detection techniques for system security.
- outline web security threats and counter measures.

Course Content

UNIT - I: Security Fundamentals

Security attacks, security services, security mechanisms, a model for network security. non- cryptographic protocol vulnerabilities - session hijacking and spoofing. software vulnerabilities - phishing, buffer overflow, format string attacks, SQL injection.

UNIT - II: Secret Key Cryptography

Symmetric cipher model, block and stream ciphers, Data Encryption Standard (DES), strength of DES, block cipher design principles and modes of operation, triple DES, AES structure.

UNIT - III: Public-Key Cryptography

Public key cryptography, principles of public key crypto systems, RSA algorithm, diffie-Hellman key exchange, introduction to elliptic curve cryptography.

UNIT - IV: Hash Functions and Digital Signatures

Cryptographic hash functions, applications of cryptographic hash functions, secure hash algorithm, digital signatures, digital Signature schemes.

UNIT - V: E-mail Security & IP Security

E-mail Security: PGP, S/MIME. IP Security: Overview, IP security architecture, authentication header, encapsulating security payload.

UNIT - VI: Web Security & System Security

Web Security -Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS).

System Security -Firewall design principles, intrusion detection systems

Text Books

1. William Stallings, "Cryptography and Network security principles and practice" 5thedition, Pearson education 2011.
2. Bernard Menezes, "Network security and cryptography", Cengage learning 2011.

Reference Books

1. William Stallings,"Network Security Essentials", 4th Edition, Pearson education.
2. Eric Maiwald, "Fundamentals of Network Security", 1st Edition,Dreamtech press.
3. Buchmann, "Introduction to Cryptography", Springer.

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Professional Elective - III

MIXED SIGNAL IC DESIGN

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

The student will be introduced to the

- basic principles of switched capacitor circuits and PLL applications.
- Understand the specifications and architectures of data converters, mixed signal layout issues.
- advanced CMOS logic design and different building blocks of digital integrated circuits.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the switched capacitor circuits.
- explore the fundamentals and different architectures of ADCs and DACs, mixed signal layout issues.
- use PLLs for various applications.
- characterize various digital IC building blocks.

Course Content

UNIT - I: Introduction to Switched Capacitor Circuits

General considerations, sampling switches, MOSFET as a switch, speed considerations, precision considerations, charge injection cancellation, switched capacitor amplifiers-unity gain sampler/buffer, non inverting amplifier, precision multiply by two circuit, switched capacitor integrator, switched capacitor common mode feedback.

UNIT - II: Data Converter Fundamentals

Analog verses discrete time signals, converting analog signals to digital signals, sample and hold characteristics, digital to analog converter specifications, analog to digital converter specifications, VLSI layout, layout steps, mixed signal layout issues.

UNIT - III: DAC Architectures

Digital input code, resistor string, R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, Pipeline DAC.

UNIT - IV: ADC Architectures

Flash, the two step flash ADC, the pipeline ADC, integrating ADCs, the successive approximation ADC, the oversampling ADC.

UNIT - V: Phase-Locked Loop

Simple PLL, phase detector, basic PLL topology, charge pump PLLs, problem of lock acquisition, phase/frequency detector and charge pump, basic charge pump PLL, jitter in PLLs, delay locked loops, applications-frequency multiplication, skew reduction, jitter reduction.

UNIT - VI: Advanced CMOS Logic Design

Domino–CMOS logic, No Race logic, differential CMOS, dynamic differential CMOS, digital integrated system building blocks-multiplexers and decoders, barrel shifters, counters, digital adders, digital multipliers.

Text Books

1. Behzad Razavi (2002), Design of Analog CMOS Integrated Circuits, TMH Edition.
2. R. Jacob Baker (2003), CMOS Circuit Design, layout and simulation, PHI
3. Ken Martin (2002), Digital integrated circuit design, Oxford university press.

Reference Books

1. David A. Johns, Ken Martin (2013), Analog Integrated Circuit Design, Wiley Student Edition.
2. R. Jacob Baker (2009), CMOS Mixed Signal Circuit Design, Wiley Wiley Student Edition.

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Professional Elective - III

CELLULAR AND MOBILE COMMUNICATIONS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce various issues of cellular radio system design.
- To expose students to different types of interferences occurred in cellular systems.
- To familiarize the students to various multiple access techniques and wireless systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the characteristics of radio environment.
- apply the concepts of frequency reuse and cell splitting to increase the capacity of cellular system.
- analyse different interferences in a cell to improve the performance of the system.
- create a cellular system model for a given region considering terrain configuration.
- design an efficient frequency management and channel assignment scheme by selecting proper handoff mechanism.
- conceptualize GSM and multiple access schemes.

Course Content

UNIT - I: Cellular Mobile Radio Systems

Introduction to cellular mobile system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, analog cellular systems.

UNIT - II: Elements of Cellular Radio System Design

Concept of frequency reuse, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, cell splitting, consideration of the components of cellular system.

UNIT - III: Interference

Introduction to co-channel interference, real time co-channel interference, design of antenna system, antenna parameters and their effects, diversity receiver, non-cochannel interference.

UNIT - IV: Cell Coverage for Signal and Traffic

Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation antenna height gain, form of a point to point model.

UNIT - V: Frequency Management and Channel Assignment

Numbering and grouping, setup, access and paging channels, channel assignments to cell sites and mobile units, channel sharing and borrowing, underlay-overlay arrangement, non fixed channel assignment.

Handoff Mechanism: Dropped call rates, types of handoff initiation, and types of handoff, and vehicle locating methods.

UNIT - VI: Digital Cellular Networks

GSM architecture, GSM channels, multiplex access schemes – FDMA, TDMA, CDMA

Text Books

1. W.C.Y. Lee, "Mobile Cellular Telecommunications", Tata McGraw Hill, 2nd Edition; 2006.(Units: I to V)
2. Theodore. S. Rapport, "Wireless Communications", Pearson Education, 2nd Edition;2002. (Unit: VI)

Reference Books

1. Jon W. Mark and Weihua Zhqung, "Wireless Communication and Networking", PHI, 2005.
2. R. Blake, "Wireless Communication Technology", R. Blake, Thompson Asia Pvt. Ltd., 2004.

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Professional Elective - III

DIGITAL TV ENGINEERING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the television standards and TV signal transmission.
- To introduce the concepts of digital TV engineering.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand color Television standards and their specifications.
- conceptualize the operation of color Television system.
- find the applications of Digital TV.

Course Content

UNIT - I: Introduction to TV Standards

Standard scanning sequence, line frequency and frame frequency, Video band width, composite video signal, blanking, synchronizing and equalizing pulses. CCIR-B Standard specifications.

UNIT - II: Colour Television

Block diagram of colour TV receiver, PAL – D decoder, Separation of U and Vsignals, Color burst separation and Burst phase discriminator, Indent and color killer circuits, U & V demodulators, Colour signal mixing.

UNIT - III: Sync Separation and AFC

AGC, Keyed AGC and noise cancellation, Synchronous separation, K noise in sync pulses and separation of frame and line sync pulses, Deflection Oscillators.

UNIT - IV: Digital Television Transmission Standards

ATSC terrestrial transmission standard, vestigial sideband modulation, DVB -T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2.

UNIT - V: Performance Objectives for Digital Television

System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, co-channel interference, adjacent channel interference, analog to digital TV, transmitter requirements.

UNIT - VI: Television Applications

Remote control circuit, CCTV systems, video tape recording and playback circuit, HDTV, TV via satellite, Remote Control, DTH system.

Text Books

1. R.R.Gulati, "Monochrome Television Practice, Principles, Technology and servicing." Third Edition 2006, New Age International Publishers.(Units:I toIII,VI)
2. Gerald W. Collins, "Fundamentals of Digital Television Transmission", John Wiley, 2001.(Units: IV to VI)

Reference Books

1. A.M Dhake, "Television and Video Engineering", 2nd ed., TMH, 2003.
2. R.P.Bali, "Color Television, Theory and Practice", Tata McGraw-Hill, 1994.

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Professional Elective - III

DSP PROCESSORS AND ARCHITECTURES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the Architecture and interfacing of TMS320C54XX processors.
- Conversant with applications of DSP processors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the concepts of Sampling, DFT and Filters.
- calculate DSP computational Errors.
- identify the Architectural features of DSP processors.
- interface I/O and memory devices with DSP Processors.

Course Content

UNIT - I: Computational Accuracy in DSP Implementations

Number formats for signals and coefficients in DSP systems, dynamic range and precision, sources of error in DSP implementations, A/D Conversion errors, DSP computational errors, D/A conversion errors, compensating filter.

UNIT - II: Architectures for Programmable DSP Devices

Basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing.

UNIT - III: Programmable Digital Signal Processors – TMS320C54XX

Data addressing modes, memory space, program control, instructions and programming, on-chip peripherals, interrupts pipeline operation.

UNIT - IV: Analog Devices Family of DSP Devices

Analog devices family of DSP devices-ALU and MAC block diagram, shifter instruction, base architecture of ADSP 2100, ADSP-2181 high performance processor.

UNIT - V: Blackfin Processor

Introduction to Blackfin processor-The Blackfin Processor, introduction to micro signal architecture, overview of hardware processing units and register files, address arithmetic unit, control unit, bus architecture and memory, basic peripherals.

UNIT - VI: Applications of Programmable DSP Devices

Introduction, DSP- based biotelemetry receiver: Pulse Position Modulation, decoding scheme for the PPM Receiver, biotelemetry receiver implementation, ECG signal processing for heart rate determination, brain tumor detection using DSP processor.

Text Books

1. Avtar Singh and S. Srinivasan –,"Digital Signal Processing" , Thomson Publications, 2004.
2. K Padmanabahan, R.Vijayarajeswaran, Ananthi. S, "A practical Approach to Digital Signal Processing", New Age International, 2006/2009

Reference Books

1. Woon-SengGan, Sen M. Kuo, "Embedded Signal Processing with the Micro signal Architecture", Wiley - IEEE Press, 2007.
2. B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", 2004, TMH.
3. Jonatham Stein, "Digital Signal Processing", John Wiley, 2005.

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Professional Elective - IV

SYSTEM ON CHIP DESIGN

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide an overview on System-On-Chip design technology.
- To introduce components in a typical SoC system.
- To familiarize with the concept of different processor cores.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand architecture designs and their design issues, Core Libraries and EDA Tools required for SoC Design.
- explore design methodology for Logic Cores, Soft and Hard Cores, Memory and Analog Cores.
- perform SoC Design validation, prototyping and verification.
- design SoCs for various applications.

Course Content

UNIT - I: Introduction to Architecture Designs

Architecture and Design Issues of SoC, Hardware Software Co-Design, Co-Design Flow, Core Libraries, EDA Tools and Web Pointers.

UNIT - II: Design Methodology for Logic Cores

SoC Design Flow, Guidelines for Design Reuse, Synchronous Design, Memory and Mixed-Signal Design, On-Chip Buses, Clock Distribution, Clear/Set/Reset Signals, Physical Design, Deliverable Models

UNIT - III: Design Process for Soft and Firm Cores

Design Flow, Design Process for Hard Cores, Sign-Off Checklist, Deliverables – Soft Core and Hard Core, System Integration – Designing with Hard Cores, Designing with Soft Cores, System Verification.

UNIT - IV: Design Methodology for Memory Cores and Analog Cores

Memory Cores: Embedded Memories and Design Methodology, Specifications of Analog Circuits, Circuit Techniques, Memory Compiler, Simulation Models.

Analog Cores: Analog-To-Digital Converter, Digital-To-Analog Converter, Phase-Locked Loops, High Speed Circuits

UNIT - V: Design Validation

Core-Level Validation, Core Validation Plan, Test Benches, Core-Level Timing Verification, Core Interface Verification, Protocol Verification, Gate-Level Simulation, SoC Design Validation, Co-Simulation, Emulation, Hardware Prototypes.

UNIT - VI: Core and SoC Design Examples

Micro Processor Cores, V830 R/AV Super Scalar RISC Core, Design Of Power PC 603e G2 Core, Memory Core Generators, Core Integration And On-Chip Bus, Examples Of Soc, Media Processors, And Testability Of Set-Top Box SoC.

Text Book

1. Rochit Raj Suman,"System-on-a-chip: Design and Test", Artech House, 2000

Reference Books

1. Jason Andrews – Newness"Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) ", BK and CDROM.
2. Prakash Rashinkar, Peter Paterson and Leena Singh L "System on Chip Verification – Methodologies and Techniques", Kluwer Academic Publishers, 2001.
3. Ricardo Reis,"Design of System on a Chip: Devices and Components", 1st Ed., Springer 2004.

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Professional Elective - IV

WIRELESS SENSOR NETWORKS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand the design issues in ad hoc and sensor networks.
- To familiarize the architecture, protocols of wireless sensor networks.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain the concepts, network architectures and applications of ad hoc and wireless sensor Networks
- analyse the protocol design issues of ad hoc and sensor networks.
- design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues.
- evaluate the QoS related performance measurements of ad hoc and sensor networks.

Course Content

UNIT - I: Introduction

Fundamentals of wireless communication technology- the electromagnetic spectrum, radio propagation mechanisms, characteristics of the wireless channel, applications of Ad Hoc and Sensor networks, design challenges in Ad hoc and Sensor Networks.

UNIT - II: Physical Layer and Transceiver Design Considerations

Personal area networks, hidden node problem, exposed node problem, topologies of PAN'S, topologies of MANETS, topologies of WANETS.

UNIT - III: MAC Protocols For Ad Hoc Wireless Networks

Issues in designing a MAC Protocol- classification of MAC protocols- contention based protocols-contention based protocols with reservation mechanisms contention-based protocols with scheduling mechanisms – multi channel MACIEEE 802.11.

UNIT - IV: Routing Protocols and Transport Layer in Ad Hoc Wireless Networks

Issues in designing a routing and transport layer protocol for Ad hoc networks proactive routing, reactive routing (on-demand), hybrid routing- classification of transport layer solutions-TCP over Ad hoc wireless networks.

UNIT - V: Wireless Sensor Networks (WSNs) and MAC Protocols

Sensor network architecture, data relaying and aggregation strategies, MAC layer protocols: self-organizing, hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

UNIT - VI: Sensor Network Platforms and Tools

Sensor node hardware–Berkeley motes, programming challenges, node-level software platforms, node-level simulators, state-centric programming.

Application of WSN: Ultrawide band radio communication, wireless fidelity systems. future directions, home automation, smart metering applications.

Text Books

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.
2. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005.

Reference Books

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor NetworksTechnology, Protocols, and Applications", John Wiley, 2007.
4. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

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Professional Elective - IV

SATELLITE COMMUNICATION

IV Year – I Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce fundamentals of satellite communications, satellite launching vehicles and subsystems of the satellite.
- To familiarize link design in satellite communications, multiple access techniques and GPS.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate the knowledge of orbital parameters and satellite launching techniques.
- compare the role of various satellite subsystems.
- design satellite link for required specifications.
- understand the coordination of earth stations for efficient utilization of the satellite by means of multiple accessing techniques.
- develop a virtual satellite earth station.
- navigate the receiving station by global positioning system.

Course Content

UNIT - I: Introduction

A brief history of satellite communications, orbital mechanics and launchers: orbital mechanics, look angle determination, orbital perturbations, orbit determination, launches and launch vehicles, orbital effects in communication systems performance.

UNIT - II: Satellite Subsystems

Attitude and orbit control system, telemetry, tracking, command and monitoring, power systems, communication subsystems.

UNIT - III: Satellite Link Design

Basic transmission theory, system noise temperature and G/T ratio, design of down links, up link design, design of satellite links for specified C/N, system design example.

UNIT - IV: Multiple Access

Frequency division multiple access (FDMA), intermodulation, calculation of C/N. Time division Multiple Access (TDMA), frame structure, examples, satellite switched TDMA. onboard processing, DAMA, code division multiple access (CDMA), spread spectrum transmission and reception.

UNIT - V: VSAT Systems

Introduction, overview of VSAT systems, network architectures, access control protocols, basic techniques, VSAT earth station engineering.

UNIT - VI: Satellite Navigation & The Global Positioning System

Radio and satellite navigation, GPS position location principles, GPS receivers and codes, satellite signal acquisition, GPS navigation message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, differential GPS.

Text Books

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt "Satellite Communications", 2nd Edition John Wiley India, 2006.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud "Satellite Communications Engineering", 2nd Edition, Pearson Publications, 2003.

Reference Books

1. M. Richharia "Satellite Communications: Design Principles", BS Publications, 2nd Edition, 2003.
2. D.C Agarwal "Satellite Communication", Khanna Publications, 5th Edition.
3. K.N. Raja Rao "Fundamentals of Satellite Communications", PHI, 2004
4. Dennis Roddy "Satellite Communications", McGraw Hill, 2nd Edition, 1996.
5. G.S.Rao "Global navigation satellite systems-with essentials of satellite systems", McGrawHill.

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Professional Elective - IV

DIGITAL IMAGE PROCESSING

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce fundamental concepts of image processing and different operations on image elements.
- To expose to the practical problems associated with processing of an image.
- To familiarize with advanced image processing operations.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the need for image transforms, types and their properties.
- process the images for the enhancement of certain properties or for optimized use of the resources.
- explore causes for image degradation and to develop various restoration techniques.
- evaluate the image compression techniques

Course Content

UNIT - I: Fundamentals of Image Processing and Image Transforms

Introduction, fundamental steps in image processing, components of image processing system, image sensing and acquisition, image formation model, image sampling and quantization, pixel relationships, image distance measures.

Image Transforms - Need for image transforms, properties of DFT, Discrete Cosine Transform, Hadamard transform, Walsh transform, Haar transform, Slant transform.

UNIT - II: Image Enhancement

Spatial Domain: Gray level transformations, histogram processing, spatial filtering smoothing and sharpening. **Frequency Domain:** Filtering in frequency domain – smoothing and sharpening filters, homomorphic Filtering.

UNIT - III: Image Restoration

Image degradation model, noise modeling, image restoration in the presence of only noise-mean filters, order statistic filters, band reject filters, band pass filters, notch filter inverse filter, wiener filter.

UNIT - IV: Image Segmentation and Morphology

Detection of discontinuities, edge detection, threshold based segmentation, region based segmentation – region growing, region splitting and merging.

Morphology: dilation, erosion, opening and closing, hit or miss transformation, basic morphological algorithms.

UNIT - V: Image Compression

Image Compression: Fundamentals, image compression model, types of redundancy, variable length coding, arithmetic coding, LZW coding, bit-plane coding, runlength coding.

UNIT - VI: Color Image Processing

Color Image Processing: Color fundamentals, color models-RGB,CMYK and HSI, color transformations.

Applications of Image Processing: Content based image retrieval systems, digital watermarking, image mosaicing and image compositing.

Text Books

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 2nd edition, Pearson Eduction, 2003.(Units: I-V except image transforms)
2. S.Sridhar, "Digital Image Processing",Oxford University Press,2011. (Unit-I image transforms and Unit-VI).

Reference Books

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India,2nd edition 2004.
2. S.Jayaraman, "Digital Image Processing", Tata McGraw-Hill Education, 2011.

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Optional Elective - VII

DIGITAL CONTROL SYSTEMS

IV Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts on digital control systems and their associated components.
- To impart knowledge on z–transformations for the analysis of digital control systems.
- To familiarize with the concepts on state model representation of discrete–time systems and its stability testing methods.
- To impart knowledge on design of state feedback controller using pole placement method.

Learniang Outcomes

Upon successful completion of the course, the students will be able to

- specify the components of digital control systems.
- employ z–transformations to analyze digital control systems.
- assess the stability of digital systems and suggest methods to improve stability margins.
- employ the state–space representation for the analysis and design of digital systems.

Course Content

UNIT - I: Introduction And Signal Processing

Introduction to analog and digital control systems – advantages of digital systems – typical examples – signals and processing – sample and hold devices – sampling theorem and data reconstruction – frequency domain characteristics of zero order hold.

UNIT - II: Z–Transformations

Z–Transforms–theorems – finding inverse z–transforms – formulation of difference equations and solving – block diagram representation – pulse transfer functions and finding open loop and closed loop responses.

UNIT - III: State Space Analysis and The Concepts of Controllability and Observability

State space representation of discrete time systems – state transition matrix and methods of evaluation – discretization of continuous – time state equations – concepts of controllability and observability – tests.

UNIT - IV:Stability Analysis

Mapping between the S–Plane and the Z–Plane – primary strips and complementary strips – stability criterion – modified Routh's stability criterion and jury's stability test.

UNIT - V: Design of Discrete–Time Control Systems By Conventional Methods

Transient and steady state specifications – design using frequency response in the w–plane for lag and led compensators – root locus technique in the z– plane.

UNIT - VI: State Feedback Controllers

Design of state feedback controller through pole placement – necessary and sufficient conditions – Ackerman's formula.

Text Books

1. K. Ogata, "Discrete Time Control systems", Pearson Education/PHI, 2nd Edition
2. M. Gopal, "Digital Control and State Variable Methods", Tata Mc Graw-Hill Companies, 1997.

Reference Books

1. Kuo, "Digital Control Systems", Oxford University Press, 2nd Edition, 2003.
2. M.Gopal, "Digital Control and State Variable Methods", TMH.

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Optional Elective - VII

ARTIFICIAL INTELLIGENCE

IV Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objective

- To familiarize the concepts of AI for representation of knowledge and problem solving.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the problems that are amenable and can be solved by using AI techniques.
- analyse the problem solving and game playing techniques.
- specify the classical Artificial Intelligence algorithms, which are used to solve the heuristic search and game playing problems.
- apply the basic principles and algorithms of Artificial Intelligence to recognise, model and solve the state space search, knowledge representation and reasoning problems.
- formulate the Reasoning model and state the conclusion for the uncertainty problems using actions and their effects over the time.
- describe expert systems and their applications.

Course Content

UNIT - I: Introduction to Artificial Intelligence

Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, current trends in AI.

UNIT - II: Problem solving and game playing

State-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques-Hill climbing, iterative-deepening A*, problem reduction, constraint satisfaction.

Game playing: Introduction, game playing, min-max algorithm, alpha-beta pruning.

UNIT - III: Logic Concepts

Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic table system in proportional logic, resolution in proportional logic, resolution in predicate logic and unification algorithm.

UNIT - IV: Knowledge Representation

Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames.

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure.

UNIT - V: Reasoning in Uncertain Situations

Introduction to non-monotonic reasoning, truth maintenance systems, logics for non-monotonic reasoning, classical planning problem: Goal stack, hierarchical planning.

UNIT - VI: Expert Systems and Applications

Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, blackboard systems, model-based expert system, case-based expert system and hybrid expert system and application of expert systems.

Text Books

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", Tata McGraw Hill edition, 2nd edition.
2. Stuart J. Russell, "Artificial Intelligence: A Modern Approach", 2nd edition.

Reference Books

1. Patrick Henry Winston, "Artificial Intelligence", 3rd edition, Pearson Education.
2. Russel and Norvig, "Artificial Intelligence", 3rd edition, Pearson Education, PHI.
3. Patterson, "Introduction to Artificial Intelligence and Expert Systems", 2nd edition, PHI publication.

Web Links

1. https://onlinecourses.nptel.ac.in/noc18_cs19
2. https://www.tutorialspoint.com/artificial_intelligence/index.htm
3. https://www.ibm.com/developerworks/library/cc-beginner-guide-machine-learning-ai-cognitive/index.html

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Optional Elective - VII

TRANSFORM TECHNIQUES

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with wavelet transforms and multi rate analysis.
- To impart the knowledge of wavelet packets and wavelet generation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze various signals using Fourier and wavelet transforms.
- apply different transform techniques for the analysis of one and two dimensional signals.
- describe various filter banks and signal reconstruction techniques.
- perform different processing operations using thresholding techniques.

Course Content

UNIT - I: STFT and Introduction of Wavelet Transform Time – frequency analysis: window function, short time Fourier transform, discrete short time Fourier transform, continuous wavelet transform, discrete wavelet transform, wavelet series, interpretation of the time-frequency plot.

UNIT - II: Transforms -Walsh, Hadamard, Haar and Slant transforms, DCT, DST, KLT, singular value decomposition; definition, properties.

UNIT - III: Continuous Wavelet Transform (CWT) - Short comings of STFT, need for wavelets, wavelet basis- concept of scale and its relation with frequency, continuous time wavelet transform equation- series expansion using wavelets, CWT, tiling of time scale plane for CWT. Haar, Mexican hat, Shannon, and Daubechies wavelets.

UNIT - IV: Multi resolution analysis-Image pyramids,subband coding,multi resolution expansions, two-channel filter banks, perfect reconstruction condition, relationship between filter banks and wavelet basis.

UNIT - V: Discrete Wavelet Transform (DWT)- DWT, structure of DWT filter banks,scaling function and its properties,wavelet function and its properties, Daubechies wavelet function, applications of DWT.

UNIT - VI: Wavelet Packets and Lifting- Wavelet packet transform and algorithms, hard and soft thresholding, multidimensional wavelets, bi-orthogonal basis - B-splines, lifting scheme of wavelet generation, multi wavelets.

Text Books

1. K.P.Soman and K.I Ramachandran, "Insight into Wavelets – from theory to practice" PHI, Second Edition,2008.(All Units)
2. Jaideva C Goswami, Andrew K Chan,"Fundamentals of Wavelets- Theory", Algorithms and Applications", John Wiley & Sons, Inc, 1999. (Units: I, III, IV, V)

Reference Books

1. Raghuveer M.Rao and Ajit S. Bopardikar, "A Wavelet Tour of Signal Processing Theory and Applications", Pearson Edu, 2003.
2. S.Jayaraman, S.Esakkirajan, T.Veera Kumar , "Digital Image Processing", Tata McGraw Hill, 2009.

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Professional Elective - V

LOW POWER VLSI CIRCUITS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To make the students familiarize with the sources of power dissipation and power minimization techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the requirements for low power
- distinguish static and dynamic power dissipations
- apply voltage scaling approaches to reduce dynamic power
- apply various methods to minimize switched capacitance
- identify suitable leakage power minimization technique
- describe low power design methodologies such as adiabatic circuits.

Course Content

UNIT - I: Low Power Requirements

Historical background, requirements for low power, sources of power dissipation, low power design methodologies.

UNIT - II: Sources of Power Dissipation

Short circuit power dissipation, switching power dissipation, glitching power dissipation, leakage power dissipation.

UNIT - III: Supply Voltage Scaling Approaches

Device feature size scaling, architectural level approaches, voltage scaling using high-level transformations, multilevel voltage scaling.

UNIT - IV: Switched Capacitance Minimization Approaches

Hardware software trade-off, bus encoding, clock gating, glitching power minimization, logic styles for low power.

UNIT - V: Leakage Power Minimization Approaches

Variable-Threshold voltage CMOS (VTCMOS) approach, transistor stacking, Multi-Threshold-voltage CMOS (MTCMOS) approach, power gating.

UNIT - VI: Adiabatic Logic Circuits

Adiabatic charging, adiabatic amplification, adiabatic logic gates, pulsed power supply, partially adiabatic circuits.

Text Books

1. Jan M. Rabaey and Massoud Pedram, "Low Power Design Methodologies", Kluwer Academic Publishers, 1996 (Unit-I).
2. Ajit Pal, Low Power VLSI Circuits and Systems, Springer India, 2015 Edition (Units - II to VI)

Reference Books

1. Sung Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata Mcgraw Hill, Third Edition.
2. Neil H. E. Weste and K. Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley (Indian reprint), Second Edition.
3. A. Bellamour and M. I. Elmasri, "Low Power VLSI CMOS Circuit Design", Kluwer Academic Press, 1995.
4. Anantha P. Chandrakasan and Robert W. Brodersen, "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995.
5. Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Design", Wiley-Interscience, 2000.
6. Prof. Ajit Pal, Department of Computer Science and Engineering, IIT Kharagpur, Low Power VLSI Circuits & Systems, NPTEL video course.

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Professional Elective - V

REAL TIME OPERATING SYSTEMS

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the basic concepts of real time operating system, skills necessary to design and develop embedded applications by means of real time operating systems.
- To get acquaint with the Unix / Linux and RTLinux basic concepts and programming.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the concepts of real time operating system.
- develop software for embedded systems using the system design techniques.
- identify how to port RTOS on a microcontroller based development board.
- model real-time applications using Unix/Linux and RTLinux programming.

Course Content

UNIT - I: Introduction to Real Time Operating Systems

Multiple processes and multiple threads in an application, tasks, task states, task and data, OS services, process management, timer functions, event functions, memory management, device, file and IO systems management, interrupt routines in RTOS environment and handling of interrupt source calls, Real-Time Operating Systems, basic design using an RTOS.

UNIT - II: Real Time Operating Systems

RTOS task scheduling models interrupt latency and response of the tasks as performance metrics, OS security issues, basic functions and types of RTOS for embedded systems, basic features of RTOS mCOS-II, Vx works, Windows CE and OSEK.

UNIT - III: Target Image Creation

Off-the-shelf operating systems, operating system software, target image creation for Windows XP embedded, porting RTOS on a micro controller based development board.

UNIT - IV: Programming in Linux

Overview and programming concepts of Unix/Linux, shell programming, system programming – fork demo, semaphores and Mutex.

UNIT - V: Programming in RTLINUX

Overview of RT Linux, Core RT Linux API, program to display a message periodically, Semaphore management, Mutex management.

UNIT - VI: Case Studies-Program Modeling with RTOS

Case study - digital camera hardware and software architecture, coding for sending application layer byte streams on a TCP/IP network using RTOS Vx works. Case study of embedded systems - for an adaptive cruise control system in a car and for a smart card.

Text Books

1. Rajkamal: "Embedded Systems-Architecture, Programming and Design", Tata McGraw Hill Publications, 2nd Edition, 2008 (For units: I, II & VI).
2. Dr. K.V.K.K. Prasad: "Embedded/Real-Time Systems", Dream Tech Publications, 2003. (For units: I, III, IV & V)

Reference Books

1. Jean J.Labrosse, "Embedding system building blocks", CMP publishers, 2nd Edition.
2. Rob Williams, "Real time Systems Development", Butterworth Heinemann Publication, 2006.

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Professional Elective - V

SPEECH PROCESSING

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with speech production, speech analysis and speech processing.
- To introduce the concepts of coding of speech, speech enhancement, speech and speaker recognition systems

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand how speech is produced.
- perform speech analysis and homomorphic processing of speech signals.
- code the speech signals using linear predictive analysis.
- enhance the speech signals and recognize speech as well as speaker.

Course Content

UNIT - I: Speech Production

Anatomy and Physiology of Speech organs- Lungs, Larynx and vocal tract, Articulatory Phonetics, Acoustic Phonetics, Acoustic theory of speech production, Lossless Tube Models, Digital Models for Speech Signals.

UNIT - II: Speech Analysis

Short–Time Speech Analysis: Windowing, Spectra of Windows, Time domain parameters- Signal analysis in time domain, Short time average energy, magnitude, zero-crossing rate and auto correlation function, Frequency domain (Spectral) Parameters : Short–Time Fourier Transform Analysis, Spectral Displays, Formant Estimation and Tracking, Energy separation.

UNIT - III: Homomorphic Speech Processing

Homomorphic systems for Convolution, Complex cepstrum of speech, Pitch detection, formant estimation, Homomorphic Vocoder.

UNIT - IV: Linear predictive coding (LPC) of Speech

Basic principles of Linear predictive Analysis, Computation of Gain, Solution of LPC Equation- Cholesky Decomposition solution for covariance method and Durbin's Recursive Solution for the Autocorrelation Equations, Prediction error

Signal, Frequency domain interpretation of mean squared prediction error, Applications of LPC parameters –pitch detection and Formant analysis using LPC parameters.

UNIT - V: Speech enhancement

Nature of interfering sounds, Spectral subtraction, Filtering and adaptive noise cancellation, Multi-Microphone Adaptive Noise Cancellation.

UNIT - VI: Networks for speech recognition

Hidden Markov Model (HMM), training and testing using HMMs, adapting to variability in speech.

Speech Recognition Systems: Isolated Digit Recognition system and continuous Digit Recognition system, LPC Distance measures .

Speaker Recognition Systems: Verification vs Recognition, Speaker verification system and speaker identification system

Text Books

1. Douglas O Shaughnessy, "Speech Communications", Second Edition, Oxford University Press, 2000 (Units I, II, V,VI).
2. L.R. Rabiner and S.W. Schafer, "Digital Processing of Speech Signals", Person Education (Units I,III, IV, VI).

Reference Books

1. Thomas F. Quatieri , "Discrete –Time Speech signal Processing Principles and Practice", Person Education.
2. Dr. Shaila D. Apte, "Speech and Audio Procesing" , WILEY Precise Textbook.
3. Claudio Becchetti and Klucio Prina Ricotti, "Speech Recognition Theory and C++ Implementation",WILEY.

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Professional Elective - V

ADAPTIVE SIGNAL PROCESSING

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts of Wiener and Kalman filtering.
- To familiarize with the concepts of linear and non-linear adaptive signal processing techniques.

Course Outcomes:

Upon successful completion of the course, the students will be able to

- understand the concept of adaptive filters.
- apply Wiener and Kalman filters for signal processing applications.
- apply LMS and RLS algorithms for adaptive filter applications.
- understand the concepts of linear and non-linear adaptive signal processing techniques.

Course Content

UNIT - I: Introduction To Adaptive Filtering

Introduction to stochastic processes, linear adaptive filter structure, real and complex forms of adaptive filter, non-linear adaptive filter, adaptation approaches: Wiener filter theory method of least squares.

UNIT - II: Optimal Wiener Filtering

Mean-Square Error criterion, linear optimum filtering statement, principle of orthogonality, Wiener-Hopf equation, error performance surface, numerical examples, channel equalization, linear constrained minimum variance filter.

UNIT - III: Kalman Filtering

Statement of Kalman filtering problem, estimation of state using innovation, variance of Kalman filtering, extended Kalman filtering.

UNIT - IV: Linear Adaptive Filtering

Method of steepest descent, stability of steepest descent, least mean square algorithm, adaptive prediction, adaptive equalization, robustness of LMS algorithm, block adaptive filter, fast LMS algorithm, unconstrained frequency-domain adaptive filtering, methods of least squares.

UNIT - V: Recursive Least Squares

Matrix inversion lemma, weighted recursive least squares algorithm, adaptive noise canceller, convergence analysis of RLS algorithm, adaptive equalization, state-space formulation of RLS problem, adaptive beam-forming, order recursive adaptive Filter.

UNIT - VI: Non-Linear Adaptive Filtering

Introduction to blind de-convolution, back-propagation learning, radial basis function learning, stochastic gradient approach, Markov model, singular value decomposition.

Text Books

1. Simon Haykin,"Adaptive Filter Theory", Prentice Hall International", 3rd Edition., 2002.
2. Bernard Widrow and Samuel Stearns,"Adaptive Signal Processing", Pearson Education, 2nd Edition., 1995.

Reference Books

1. Ali H. Sayed,"Fundamentals of Adaptive Filtering", Wiley, 1st Edition., 2003.
2. Farhang-Boroujeny B.,"Adaptive Filters Theory and Applications", John Wiley & Sons, 1st Edition.,1998.
3. Mohamed Ibnkahla(Edited),"Adaptive Signal Processing in Wireless Communications", CRC Press, Taylor &Francis Group, 1st Edition., 2009.

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Professional Elective - VI

ASIC DESIGN

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce design issues and tools related to ASIC.
- To familiarize placement and routing algorithms.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the different types of ASICs and its Design Flow.
- analyze the Characteristics and Performance of Programmable ASICs, Logic cells, I/O Cells and Interconnects.
- measure goals and objectives related to Floor planning, Placement and Routing.

Course Content

UNIT - I: Programmable ASICs and ASIC Logic Cells

Programmable ASICs: Antifuse, Static RAM, EPROM and EEPROM Technology.

Programmable ASIC Logic Cells: Actel ACT and Xilinx LCA

UNIT - II: Programmable ASIC I/O Cells and Interconnect

Programmable ASIC I/O Cells: DC Output, AC Output, DC Input, AC Input, Clock Input and Power Input.

Programmable ASIC Interconnect: Xilinx LCA and Xilinx EPLD.

UNIT - III: ASIC Construction

Physical Design, CAD Tools, System Partitioning, Estimating ASIC Size and Power Dissipation

UNIT - IV: Floorplanning

Floorplanning Goals and Objectives - Measurement of Delay in Floorplanning - Floorplanning Tools - Channel Definition - I/O and Power Planning - Clock Planning.

UNIT - V: Placement

Placement Terms and Definitions, Placement Goals and Objectives – Measurement of Placement Goals and Objectives - Placement Algorithms - Timing-Driven Placement Methods, A Simple Placement Example.

UNIT - VI: Routing

Global Routing - Goals and Objectives - Measurement of Interconnect Delay - Global Routing Methods - Global Routing Between Blocks – Timing Driven Methods

Detailed Routing - Goals and Objectives - Measurement of Channel Density – Left Edge Algorithm - Constraints and Routing Graphs - Area Routing Algorithms - Multilevel Routing

Special Routing - Clock Routing - Power Routing

Text Books

1. M.J.S. Smith, "Application – Specific Integrated Circuits" Pearson Education, India.
2. H.Gerez, "Algorithms for VLSI Design Automation", John Wiley, 1999.

Reference BookS

1. J.M.Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuit Design Perspective (2/e)", PHI 2003
2. D. A.Hodges, "Analysis and Design of Digital Integrated Circuits (3/e)", MGH 2004.

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Professional Elective - VI

EMBEDDED C

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the basic concepts of embedded systems, processors, and programming languages.
- To familiarize with various interfaces, memory, and power consumption.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish C and Embedded C.
- select the processor, memory and operating system for an application.
- design and develop an application using Embedded C.

Course Content

UNIT - I: Embedded Hardware and Software

Introduction to embedded system, selection: processor, programming language and operating system; steps in developing embedded software.

Programming 8051 in C: data types and time delay, I/O programming, logical operations, data conversion, data serialization

UNIT - II: Programming 8051 in C

8051 Timer programming: simple programs on timers 0 and 1 with some delay in mode1 and mode 2, 8051 serial port programming: Transmitting and receiving data in 8051.

UNIT - III: I/O Port Programming

Basic techniques for reading from port pins, reading and writing bytes, reading and writing bits, reading and writing bits, need for pull-up resistors, dealing with switch bounce, reading switch inputs.

UNIT - IV: Object Oriented Concepts

Object-oriented programming with C, the project header (MAIN.H), the port header (PORT.H), restructuring the goat-counting example.

UNIT - V: Real-time Constraints

Introduction, creating 'hardware delays' using timer 0 and timer 1, generating a precise 50 ms delay, creating a portable hardware delay, use of timer 2, need for 'timeout' mechanism, creating loop timeouts, testing loop timeouts, reliable switch interface, creating hardware timeouts, testing a hardware timeout.

UNIT - VI: Creating an Embedded Operating System

Introduction, the basis of simple embedded OS, Introducing sEOS, using Timer 0 or Timer 1, important design considerations when using sEOS

Text Books

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008.(Units I,III,IV,V,VI)
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2008. (Units I,II)

Reference Books

1. Zdravko Karakehayov, Knud Smed Christensen, Ole Winther, "Embedded Systems Design with 8051 Microcontrollers", Marcel Dekker, Special Indian Edition, 2010.
2. Michael Barr, "Programming Embedded Systems in C and C++", Oreilly, 2003.

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Professional Elective - VI

RADAR ENGINEERING

IV Year – II Semester

Lecture : 4		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the fundamentals concepts in radar.
- To familiarize with working of different radar systems.
- To impart the knowledge of detection of radar signals in noise.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- compute different parameters from radar data.
- conceptualize the radar operation.
- distinguish moving target and pulse Doppler radars.
- understand the operation of different radar receivers.
- track different objects by using radar in different noise conditions.
- realize radar systems for electronic warfare.

Course Content

UNIT - I: Introduction

The Radar equation- introduction, detection of signals in noise, receiver noise and S/N ratio, probability function, probability of detection and false alarm, radar cross section of targets, transmitter power, pulse repetition frequency.

UNIT - II: CW Radar

Principle, doppler effect, block diagram, operation, measurement of velocity and elevation of target, applications. FMCW radar: block diagram, principle of operation, applications, salient features.

UNIT - III: MTI and Pulse Doppler Radar

Introduction, principle, MTI Radar with- power amplifier transmitter and power oscillator transmitter, delay line cancellers, frequency response, blind speeds, staggered PRFs.

UNIT - IV: Tracking Radar

Tracking with Radar, mono-pulse tracking, conical scan, sequential lobing. Radar receivers – noise figure and noise temperature, duplexers and receiver protectors, radar displays.

UNIT - V: Detection of Radar Signals in Noise

Introduction, matched filter receiver – response characteristics and derivation, correlation detection, detection criteria, detector characteristics, automatic detection, constant false alarm rate receiver

UNIT - VI: Electronic Warfare

Electronic counter measures and electronic counter-counter measures, introduction, electronic counter measures, radar jamming, electronic counter-counter measures, electronic support, stealth applications.

Text Books

1. Merrill I Skolnik "Introduction to Radar Systems", 3rd Edition, TMH, 2006
2. G.S.N.Raju "Radar Engineering and fundamentals of Navigational Aids", I.K International, 2008.

Reference Books

1. KK Sharma "Fundamentals of RADAR", sonar and Navigation Engineering, SK Kataria&Sons, 4th Edition,2014.
2. Byron Edde "Radar: Principles, Technologies, Applications", Pearson Education.

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Professional Elective - VI

MULTI RATE SIGNAL PROCESSING

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objective

- To familiarize with the concepts of interpolation and Decimation
- To familiarize with the concepts of different types of filter banks and structures.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- acquire the knowledge of multirate signal processing .
- design perfect reconstruction and near perfect reconstruction filter bank system and to learn to assess the computational efficiency of multirate systems.
- analyze the quantization effects in filter banks.
- recognize the use of filter banks in applications such as speech processing and communication

Course Content

UNIT - I: Basic Multirate Operations

Decimation and Interpolation, time-domain characterization, frequency-domain characterization, cascade equivalences, filters in sampling rate alteration systems.

UNIT - II: Uniform DFT Filter Banks

Polyphase decomposition,digital filter banks- uniform DFT filter banks, polyphase implementation of uniform filter banks, Nyquist filters.

UNIT - III: Two Channel Quadrature-Mirror Filter (QMF) Bank

Filter bank structure, analyses of two channel QMF bank, alias free filter bank, alias free realization, alias free FIR QMF bank, alias free IIR QMF bank, perfect reconstruction two channel QMF bank.

UNIT - IV: M-Channel Perfect Reconstruction Filter Banks

Uniform band and non uniform filter bank - tree structured filter bank- errors created by filter bank system- polyphase representation- perfect reconstruction systems.

UNIT - V: Paraunitary Perfect Reconstruction (PR) Filter Banks

Paraunitary PR Filter Banks- filter bank properties induced by paraunitarity- two channel FIR paraunitary QMF Bank, linear phase PR filter banks: necessary conditions for linear phase property, quantization effects: types of quantization effects in filter banks, coefficient sensitivity effects, dynamic range and scaling.

UNIT - VI: Cosine Modulated Filter Banks

Cosine modulated pseudo QMF Bank- alas cancellation, eliminating phase distortion, closed form expression for the filters, polyphase structure, PR systems

Text Books

1. P. P. Vaidyanathan. "Multirate systems and filter banks." Prentice Hall. PTR. 1993.
2. Sanjit K. Mitra. " Digital Signal Processing: A computer based approach." McGraw Hill. 1998.

Reference Books

1. J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles. Algorithms and Applications", 3rd Edn. Prentice Hall India, 1999.
2. N.J. Fliege. "Multirate digital signal processing ." John Wiley 1994.
3. R.E. Crochiere. L. R. "Multirate Digital Signal Processing", Prentice Hall. Inc.1983.

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Professional Elective - I

C# .NET

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the concepts of control structures, classes, objects in .NET
- To demonstrate the concept of exception handling and threads.
- To impart the working style of forms in web applications.
- To edify the connection to a database using web application.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- configure the .NET environment for an application.
- compose simple programs in C# using control structures.
- apply the inheritance mechanism to solve simple problems in C#.
- apply the exception handling mechanism to improve the robustness of an application.
- create user interface components for a .NET application.
- connect web pages with a database.

Course Content

UNIT - I: Introduction to .NET

Basics of .NET framework, components of .NET, architecture of .NET framework, list of .NET languages, Microsoft visual studio, benefits of .NET framework.

Basics of C#: writing a program, program structure, using specific functions and command line arguments.

UNIT - II: Control Statements

Introduction to data types, value types, classes and objects, keywords, variables, operators, special operators in C#, type casting.

Conditional Statements: if, if-else, if-else-if ladder, nested if, switch statements with examples.

Iterative Statements: while, do-while, for, foreach, break, continue statements.

UNIT - III: Classes and Objects

Introduction, design of a class, array of objects, constructors, this, static members, passing objects to function, basic object oriented programming, access level, components of a class. Inheritance: Visibility control, types of inheritances, overriding methods, abstract class and methods. Interfaces: Interface definition and syntaxes, extending interface.

UNIT - IV: Error and Exceptions

Types of errors, effective exception handling mechanism, try-catch, user defined exception, finally statement.

UNIT - V: Windows Forms and Basic Controls

Form, basic properties of form, anchor docks, controls.

Advanced Controls and Dialogs: Advanced controls, common dialogs.

UNIT - VI: Data Connectivity

Creating database in MS Access, connection object, command object, dataset and data table objects, inserting and updating records.

Introduction to ASP.NET: Difference between ASP.NET and ASP, advantages of ASP.NET, web forms, creating an ASP website, common HTML tags, creating user form, database creation in SQL Express.

Text Books

1. Harsh Bhasin, "Programming in C#", OXFORD.

Reference Books

1. Andrew Troelsen, "C# and the .NET Platform", Second Edition, Apress Publication.
2. Herbert Schildt, "The Complete Reference C# 4.0.".
3. Erik Brown, "Windows Forms Programming With C#."
4. Peter Sestoft and Henrik I. Hansen, "C# Preciesely", Prentice Hall of India.

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Professional Elective - I

ADVANCED DATA STRUCTURES
(Common to CSE & IT)
III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce dictionaries, priority queue and balanced trees.
- To disseminate knowledge on Pattern Matching Algorithms and Tries.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- illustrate representations of sets and operations on sets and dictionaries.
- construct Priority queues such as min heap and max heap for the given data.
- create AVL, Red Black, Splay, B and B+ Trees for the given data and perform insertion, deletion and search operations on them.
- search for a pattern in the given text using Pattern Matching Techniques.
- demonstrate insertion and search operations on tries and also list its applications.

Course Content

UNIT - I: Sets and Dictionaries

Sets: Definition, set representation techniques, set operations.

Dictionaries: Definition, operations, ADT for dictionary, representation of dictionaries, applications of dictionaries.

UNIT - II: Priority Queues

Introduction, types of priority queues, implementation methods of priority queues, binary heap: min heap and max heap, applications of heap.

UNIT - III: Balanced Trees-1

AVL Trees: introduction, maximum height of an AVL tree, insertion and deletion operations.

UNIT - III: Balanced Trees-2

Red Black Trees - insertion and deletion operations, splay trees- insertion and deletion operations.

UNIT - IV: B and B+ Trees

B Trees - insertion and deletion operations, B+ trees- insertion and deletion operations.

UNIT - V: Pattern Matching

Introduction, pattern matching algorithms- the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, applications of pattern matching.

UNIT - VI: Tries

Introduction, advantages of tries, digital search tree, binary trie, compressed binary trie, patricia, multi way trie.

Text Books

1. Horowitz, Sahni, Anderson Freed, "Fundamentals of Data Structure in C", 2nd edition, University Press.
2. Richard F, Gilberg, Forouzan, "Data Structures", 2nd edition, Cengage.

Reference Books

1. Mark Allen Weiss, "Data structures and Algorithm Analysis in C", Pearson, 2nd edition.
2. Debasis Samanta, "Classic Data Structures", PHI, 2nd edition.

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Professional Elective - I

SOFTWARE TESTING METHODOLOGIES

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To disseminate knowledge on software testing techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- formulate problem by following software testing life cycle.
- design test cases for testing a software project using black box testing techniques.
- apply path testing on a given program and uncover bugs present in the program.
- compare verification and validation in the context of software testing
- describe regression testing and software quality assurance.
- demonstrate the use software testing tools for testing projects.

Course Content

UNIT - I: Introduction and Methodology

Introduction, myths and facts, software testing terminology, software testing life cycle.

UNIT - II: Dynamic Testing I

Black Box Testing Techniques: Boundary value analysis, equivalence class testing, state table based testing and decision table based testing.

UNIT - III: Dynamic Testing II

White-Box Testing Techniques: Need, logic coverage criteria, basis path testing, loop testing, mutation testing, static testing: inspections-inspection team, inspection process, benefits of inspection process, structured walkthroughs, technical reviews.

UNIT - IV: Verification and Validation

Verification and validation activities, verification, verification of requirements, validation, validation activities.

UNIT - V: Regression Testing

Objectives of regression testing, when regression testing done? regression testing types, regression testing techniques. Software Quality Management: SQA models, debugging: process, techniques, correcting bugs.

UNIT - VI: Automation and Testing Tools

Need for automation, categorization of testing tools, selection of testing tools, cost incurred, guidelines for automated testing, overview of some commercial testing tools.

Text Books

1. Naresh Chauhan, "Software Testing, Principles and Practices", 1st edition, Oxford.
2. Aditya P Mathur, "Foundations of Software Testing", 2nd edition, Pearson.

Reference Books

1. Yogesh Singh, "Software Testing", Cambridge.
2. M G Limaye, "Software Testing, Principles, Techniques and Tools", TMH.
3. Willian E Perry, "Effective Methods for Software Testing", 3rd edition, Wiley.

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Professional Elective - I

PRINCIPLES OF PROGRAMMING LANGUAGES

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand and describe syntax and semantics of programming languages.
- To understand data, data types, and basic statements.
- To understand call-return architecture and ways of implementing them.
- To understand object-orientation, concurrency, and event handling in programming languages.
- To develop programs in non-procedural programming paradigms.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe syntax and semantics of programming languages.
- explain data, data types, and basic statements of programming languages.
- design and implement subprogram constructs, Apply object - oriented, concurrency, and event handling programming constructs.
- develop programs in Scheme, ML, and PROLOG.
- understand and adopt new programming languages.

Course Content

UNIT - I: Syntax and Semantics

Evolution of programming languages, describing syntax, context-free grammars, attribute grammars, describing semantics, lexical analysis, parsing, recursive-decent, bottom-up parsing.

UNIT - II: Data, Data Types, and Basic Statements

Names, variables, binding, type checking, scope, scope rules, lifetime and garbage collection, primitive data types, strings, array types, associative arrays, record types, union types, pointers and references, arithmetic expressions, overloaded operators, type conversions, relational and Boolean expressions, assignment statements, mixed mode assignments, control structures – selection, iterations, branching, guarded statements.

UNIT - III: Subprograms and Implementations

Subprograms, design issues, local referencing, parameter passing, overloaded methods, generic methods, design issues for functions, semantics of call and return, implementing simple subprograms, stack and dynamic local variables, nested subprograms, blocks.

UNIT - IV: Object- Orientation and Concurrency

Object orientation, design issues for OOP languages, implementation of object oriented constructs, concurrency, semaphores, monitors, message passing, threads, statement level concurrency, exception handling.

UNIT - V: Functional Programming Languages

Introduction to lambda calculus, fundamentals of functional programming languages, programming with scheme.

UNIT - VI: Logic Programming Languages

Introduction to logic and logic programming, programming with PROLOG, multi-paradigm languages.

Text Books

1. Robert W. Sebesta, "Concepts of Programming Languages", 10^{th} edition, Addison Wesley.
2. Allen B Tucker, Robert E Noonan, "Programming Languages, Principles and Paradigms", 2^{nd} edition, TMH.

Reference Books

1. R. Kent Dybvig, "The Scheme programming language", 4^{th} edition, MIT Press.
2. Jeffrey D. Ullman, "Elements of ML programming", 2^{nd} edition, Prentice Hall.
3. Richard A. O'Keefe, "The craft of Prolog", MIT Press.
4. W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", 5^{th} edition, Springer.

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Optional Elective - III

HUMAN COMPUTER INTERACTION

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce guidelines, principles, and theories influencing human computer interaction.
- To familiarize with range of approaches, techniques, tools and methods available to them when designing useful and usable technology.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain human and computer components functions regarding interaction with computer.
- illustrate the interaction between human and computer components.
- apply the screen design guidelines in creating User Interface.
- develop effective GUI using appropriate controls for windows based applications.
- choose appropriate widgets, components and tools for effective design of User Interface

Course Content

UNIT - I: Introduction

Importance of user interface – definition, history of screen design, importance of good design, benefits of good design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, characteristics.

UNIT - II: Design Process

Human interaction with computers, importance of human characteristics, human consideration, human interaction speeds, understanding business junctions.

UNIT - III: Screen Designing

Design goals, organizing screen elements, ordering of screen data and content, visually pleasing composition, focus and emphasis, presentation information, statistical graphics.

UNIT - IV: Windows

Navigation schemes, selection of devices based and screen based controls.

UNIT - V: Components

Text and messages, icons, colors, user problems, choosing colors.

UNIT - VI: Software Tools

Interaction Devices, speech recognition digitization and generation, image and video displays, drivers.

Text Books

1. Wilbert O. Galitz, "The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques", 2nd edition, John Wiley & Sons.
2. Ben Shneidermann, "Designing the User Interface", 3rd edition, Pearson Education Asia.

Reference Books

1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human–Computer Interaction", 3rd edition, Pearson.
2. Jenny Preece, Yvonne Rogers, Helen Sharp, "Interaction Design : Beyond Human-Computer Interaction", Wiley.
3. Soren Lauesen, "User Interface Design: A Software Engineering Perspective", Addison Wesley.

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Optional Elective - III

DIGITAL SIGNAL PROCESSING

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of discrete time signals and systems
- To introduce the concepts of Z-transform and frequency domain representation of discrete time signals.
- To familiarize with the designing of digital filters and their realization.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze and process signals in the discrete domain.
- determine the Fourier series coefficients and z-transform of discrete time signals.
- apply the various transform techniques on discrete time signals.
- design digital filters (IIR and FIR) for a given specifications.
- apply various windowing techniques in the design of FIR filter.
- realize digital filters (IIR and FIR).

Course Content

UNIT - I: Discrete Time Signals and Systems

Discrete time signals- classification, elementary discrete time signals, basic operations on sequences; discrete time systems-classification, discrete time linear time invariant systems and their properties, convolution sum.

UNIT - II: Z-Transform and Discrete Fourier series

Z transform of sequence, properties of ROC, properties of Z transform, inverse z transform- partial fraction method.

Discrete Fourier Series: Fourier series for discrete time periodic signals, Fourier Transform for discrete time aperiodic signals, energy density spectrum, relationship of Fourier transform to Z transform, frequency response.

UNIT - III: Discrete Fourier Transform

Frequency Sampling- Discrete Fourier Transform (DFT), properties of DFT, linear convolution of sequences using DFT, relationship between DFT and Z transform.

UNIT - IV: Fast Fourier Transforms (FFT)

Fast Fourier Transform-Radix-2 decimation in time and in frequency FFT algorithms, IDFT using FFT algorithms.

UNIT - V: Design of IIR Filters

Analog filter approximation-Butterworth and Chebyshev (Type-I) filters, Design of IIR filters from analog filters- Impulse invariant technique, bilinear transformation

UNIT - VI: Design of FIR Filters and Realization of Digital Filters

Linear Phase FIR filters-Frequency response, Fourier series method of designing FIR filter, design of FIR filters using windows (Rectangular, Bartlett, Hamming, Hanning).

Realization of Digital Filters: Realization of IIR filters- Direct form I, II; Realization of FIR Filters- Transversal structure, cascade realization.

Text Books

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", 4th edition, Pearson Education.

Reference Books

1. A. V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", 3rd edition, PHI.
2. Andreas Antoniou, "Digital Signal Processing", TATA McGraw Hill.
3. MH Hayes, "Digital Signal Processing", Schaum's Outline Series, 2nd edition, TATA Mc-Graw Hill.

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Optional Elective - III

CONTROL SYSTEMS

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basic concepts of control systems by developing mathematical models for physical systems.
- To equip the students to analyze the time domain behavior of linear control systems.
- To impart analytical and graphical methods to quantify stability of linear control systems.
- To introduce the state variable theory as a pre-requisite to advance control systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- develop mathematical models for physical systems.
- employ the time domain analysis to quantify the performance of linear control systems and specify suitable controllers.
- quantify time and frequency domain specifications to determine stability margins.
- apply state variable theory to determine controllability and observability of linear control systems.

Course Content

UNIT - I: Introduction

Concepts of control systems, Open loop and closed loop control systems and their differences, different examples of control systems, classification of control systems, feed-back characteristics, effects of feedback, mathematical models, differential equations, impulse response and transfer function.

UNIT - II: Control Systems Components

Transfer function of DC servo motor, AC servo motor, synchro transmitter and receiver, block diagram representation of systems considering block diagram algebra, representation by signal flow graph, reduction is using Mason's gain formula.

UNIT - III: Time Response Analysis

Standard test signals, time response of first order systems, characteristic equation of feedback control systems, transient response of second order systems, time domain specifications, steady state response, steady state errors and error constants, introduction to P, PI, PD and PID controllers.

UNIT - IV: Stability Analysis in S-Domain

The concept of stability–Routh's stability criterion, qualitative stability and conditional stability, limitations of Routh's stability.

Root locus technique: The root locus concept, construction of root loci, effects of adding poles and zeros to G(s) H(s) on the root loci.

UNIT - V: Frequency Response Analysis

Introduction, frequency domain specifications, Bode diagrams, determination of frequency domain specifications and transfer function from the Bode diagram, phase margin and gain margin, stability analysis from Bode Plots, Polar plots-Nyquist plots, stability analysis.

UNIT - VI: State Space Analysis of Continuous Systems

Concept of state, state variables and state model, derivation of state models from physical systems (Electrical), solving the time invariant state equations, state transition matrix and its properties, concepts of controllability and observability.

Text Books

1. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Limited Publishers, 2nd edition.

2. B.C.Kuo , John Wiley and sons , "Automatic Control System", 8th edition.

Reference Books

1. K.Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th edition.

2. N.K.Sinha, "Control system", New Age International (p) Limited Publishers, 3rd edition.

3. Norman S-Nice, "Control System Engineering", Willey Studio Edition, 4th edition.

4. Joseph J Distefa, "Feedback and Control System", 2nd edition.

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Professional Elective - II

ARTIFICIAL INTELLIGENCE

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize the concepts of AI for representation of knowledge and problem solving.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the problems that are amenable and can be solved by using AI techniques.
- analyse the problem solving and game playing techniques.
- specify the classical Artificial Intelligence algorithms, which are used to solve the heuristic search and game playing problems.
- apply the basic principles and algorithms of Artificial Intelligence to recognise, model and solve the state space search, knowledge representation and reasoning problems.
- formulate the Reasoning model and state the conclusion for the uncertainty problems using actions and their effects over the time.
- describe expert systems and their applications.

Course Content

UNIT - I: Introduction to Artificial Intelligence

Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, current trends in AI.

UNIT - II: Problem solving and game playing

State-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques- Hill climbing, iterative-deepening A*, problem reduction, constraint satisfaction.

Game playing: Introduction, game playing, min-max algorithm, alpha-beta pruning.

UNIT - III: Logic Concepts

Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution in proportional logic, resolution in predicate logic and unification algorithm.

UNIT - IV: Knowledge Representation

Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames.

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure.

UNIT - V: Reasoning in Uncertain Situations

Introduction to non-monotonic reasoning, truth maintenance systems, logics for non-monotonic reasoning, classical planning problem: Goal stack, hierarchical planning.

UNIT - VI: Expert Systems and Applications

Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, blackboard systems, model-based expert system, case-based expert system and hybrid expert system and application of expert systems.

Text Books

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", Tata McGraw Hill edition, 2^{nd} edition.
2. Stuart J. Russell, "Artificial Intelligence: A Modern Approach", 2^{nd} edition.

Reference Books

1. Patrick Henry Winston, "Artificial Intelligence", 3^{rd} edition, Pearson Education.
2. Russel and Norvig, "Artificial Intelligence", 3^{rd} edition, Pearson Education, PHI.
3. Patterson, "Introduction to Artificial Intelligence and Expert Systems", 2^{nd} edition, PHI publication.

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Professional Elective - II

SCRIPTING LANGUAGES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with jQuery, JSON, PERL, Ruby, AJAX to develop client-side and server-side web applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- use jQuery with DOM to manipulate HTML elements, attributes and CSS.
- store and exchange data between server and browser using JSON.
- develop PERL scripts using arrays, hashes, control structures and subroutines.
- write Ruby scripts using data types, arrays, hashes, control structures and classes.
- retrieve data from a database using PHP and AJAX

Course Content

UNIT - I: jQuery

Introduction, selectors, events, effects, manipulating HTML and CSS using jQuery

UNIT - II: JSON

Introduction, syntax rules, JSON vs XML, data types, objects, arrays, parsing JSON and using stringify() function

UNIT - III: Introduction to PERL

Basic syntax, Perl language elements: variables, operators, control flow statements, arrays, hashes and file handling; Regular expressions, subroutines

UNIT - IV: Working with PERL

Packages and modules, working with files, retrieving documents from the web with Perl.

UNIT - V: Ruby

Introduction to Ruby, variables, types, simple I/O, control, arrays, hashes, methods, classes, iterators, pattern matching. Overview of rails.

UNIT - VI: AJAX a New Approach

Introduction, creating XMLHttpRequest object, integrating AJAX with PHP, retrieving data from a database using PHP and AJAX, handling XML data using PHP and AJAX.

Text Books

1. Kogent, "HTML 5 Black Book", 2nd Edition, Dreamtech Press.
2. Dave Thomas, "Programming Ruby 1.9 & 2.0: The Pragmatic Programmers' Guide", 4th Edition, Pragmatic Bookshelf.
3. Randal L. Schwartz, ý Brian D. Foy,ý Tom Phoenix, "Learning Perl", 6th edition, O'REILLY Publications.

Reference Books

1. Uttam K Roy, "Web Technologies", Oxford
2. Chris Bates, WILEY, "Web Programming: building internet applications", Dreamtech, 2nd edition.
3. Robert W Sebesta, "Programming the World Wide Web", Pearson publications, 4th edition

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Professional Elective - II

MICROPROCESSORS AND INTERFACING

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the architecture of 8086 microprocessor.
- To introduce the assembly language programming concepts of 8086 processor.
- To impart knowledge on I/O interfacing.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the architecture of 8086 microprocessor.
- develop programs to run on 8086 microprocessor based system.
- design system using memory chips and peripheral chips for 8086 microprocessor.
- know the concepts of interrupts and serial communication using 8086.

Course Content

UNIT - I: Introduction to 8086

Features of 8086 processor, architecture-functional diagram, register organization, memory segmentation, physical memory organization, signal descriptions of 8086- common function signals, minimum and maximum mode signals, timing diagrams.

UNIT - II: Instruction Set and Addressing Modes of 8086

Instruction formats, instruction set, addressing modes

UNIT - III: Assembly language programming of 8086

Assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

UNIT - IV: Basic Peripheral Interfacing to 8086

8255 PPI-Various modes of operation and interfacing to 8086, interfacing keyboard, display, stepper motor interfacing, D/A and A/D converter.

UNIT - V: Memory Interfacing and Interrupt Structure of 8086

Memory interfacing to 8086, need for DMA, architecture of 8257,interfacing DMA controller 8257 to 8086,interrupt structure of 8086, vector interrupt table, interrupt service routine, interfacing 8259 to 8086.

UNIT - VI: Serial Communication Using 8086

Serial communication standards, serial data transfer schemes, 8251 USART architecture and interfacing, RS- 232, IEEE-4-88, prototyping and trouble shooting.

Text Books

1. D. V. Hall, "Microprocessors and Interfacing", TMGH, 2^{nd} edition.
2. Barry B.Brey, "The Intel Microprocessors –architecture, interfacing and programming", PHI, 8^{th} edition.

Reference Books

1. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", 2^{nd} edition, TMGH.
2. Triebel & Singh, "The 8088 & 8086 Microprocessors-Programming, interfacing, Hardware & Applications", PHI.

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Professional Elective - II

SOFTWARE PROJECT MANAGEMENT

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce plan and manage projects at each stage of the software development life cycle (SDLC).
- To impart effective software projects that support organization's strategic goals.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the different software projects.
- prepare project plans that address real time management challenges.
- relate important risks facing a new project.
- design effective software development model to meet organizational needs.
- recognize appropriate methodology to develop a project schedule.
- apply appropriate techniques to assess ongoing project performance.

Course Content

UNIT - I: Conventional Software Management

The waterfall model, conventional software management performance.

Evolution of software economics: Software economics, pragmatic software cost estimation.

Improving software economics: Reducing software product size, improving software processes, improving team effectiveness.

UNIT - II: Principles of Modern Software Management

The old way and the new: The principles of conventional software engineering, principles of modern software management, transitioning to an iterative process.

Life cycle phases: Engineering and production stages, inception, elaboration, construction, transition phases.

UNIT - III: Checkpoints and Process Planning

Checkpoints of the process: Major mile stones, minor milestones, periodic status assessments.

Iterative process planning: Work breakdown structures, planning guidelines, cost and schedule estimating.

UNIT - IV: Project Organizations

Project organizations and responsibilities: Line-of-Business organizations, project organizations, evolution of organizations.

Process automation: Automation building blocks.

UNIT - V: Project Control and Process Instrumentation

The seven core metrics, management indicators, quality indicators, life cycle expectations, pragmatic software metrics, metrics automation, Tailoring the process-Process discriminants.

UNIT - VI: Future Software Project Management

Modern project profiles, next generation software economics, modern process transitions.

Text Book

1. Walker Royce, "Software Project Management", 1st edition, Pearson Education.

Reference Books

1. Bob Hughes and Mike Cotterell, "Software Project Management", 5th edition, Tata McGraw-Hill.
2. Joel Henry, "Software Project Management", Pearson Education.
3. Pankaj Jalote, "Software Project Management in practice", Pearson Education.

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Optional Elective - V

GRAPH THEORY

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To apply the concepts of graph theory in real world problem solving.
- To apply a combination of theoretical knowledge and independent mathematical thinking to investigate questions in graph theory

Learning Outcomes

Upon successful completion of the course, the students will be able to

- define various types of graphs.
- identify the connectivity and planarity of graphs.
- determine chromatic number for performing partitioning of graph.
- analyze directed graphs and paths to solve path finding problems.
- discuss the principles of permutations and combinations to find all possible arrangements.
- apply generating functions to solve recurrence relations.

Course Content

UNIT - I: Introduction

Graphs –Introduction , isomorphism , sub graphs, walks, paths, Circuits–Connectedness, components , Euler graphs, Hamiltonian paths and circuits, trees, properties of trees, distance and centers in tree, rooted and binary trees.

UNIT - II: Trees, Connectivity and Planarity

Spanning trees, fundamental circuits, spanning trees in a weighted graph, cut sets, properties of cut set, all cut sets, fundamental circuits and cut sets , connectivity and separability, network flows, 1-Isomorphism , 2-Isomorphism, combinational and geometric graphs, planer graphs, different representation of a planer graph.

UNIT - III: Matrices, Colouring and Directed Graph

Chromatic number, chromatic partitioning, chromatic polynomial, matching, covering, four color problem, directed graphs, types of directed graphs, digraphs and binary relations, directed paths and connectedness, Euler graphs.

UNIT - IV: Permutations and Combinations

Fundamental principles of counting, permutations and combinations, Binomial theorem, combinations with repetition, combinatorial numbers, principle of inclusion and exclusion, derangements, arrangements with forbidden positions.

UNIT - V: Generating Functions

Generating functions, partitions of integers, exponential generating function, summation operator.

UNIT - VI: Recurrence Relations

Recurrence relations, first order and second order, non-homogeneous recurrence relations, method of generating functions.

Text Books

1. Narsingh Deo, "Graph Theory -with application to Engineering and Computer science", 1st edition, Prentice Hall of India.
2. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics, 5th edition.

Reference Books

1. Clark John and Holton D.A, "A first look at Graph Theory".
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 4th edition.

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Optional Elective - V

EMBEDDED SYSTEM DESIGN

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of embedded system design and to show how such systems are developed using a concrete platform built around.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between the general computing system and the embedded system.
- differentiate general purpose processors and single purpose processors.
- model different state machines and concurrent process.
- specify different design technologies of software and hardware design.

Course Content

UNIT - I: Introduction

Embedded System-Definition, classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, memory, sensors and actuators, communication interface, embedded firmware. Design challenge-Optimizing design metrics, processor technology, IC technology, design technology.

UNIT - II: Single Purpose Processors

RT-level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level), optimizing custom single purpose processors.

UNIT - III: General Purpose Processors

Basic architecture, operation, pipelining, programmer's view, development environment, Application Specific Instruction-Set Processors(ASIPs), micro controllers and digital signal processors.

UNIT - IV: State Machine and Concurrent Process Models

Introduction, models vs languages, finite state machines with data path model (FSMD) using state machines, program state machine model (PSM), concurrent process model.

UNIT - V: Interfacing

Communication basics, arbitration, multilevel bus architectures, advanced communication principles

UNIT - VI: Design Technology

Automation: Synthesis-parallel evolution of compilation and synthesis, synthesis levels, logic Synthesis, RT synthesis, behavioral synthesis, systems synthesis and hardware/software co-design, Verification: hardware/software co-simulation

Text Books

1. Frank Vahid, Tony D. Givargis, "Embedded System Design - A Unified Hardware/Software Introduction", John Wiley.
2. Shibu.K.V, "Introduction to Embedded Systems" - Tata McGraw Hill Education Private Limited.

Reference Books

1. Raj kamal, "Embedded Systems", 2nd edition , TMH.
2. Tammy Noergaard, "Embedded Systems Architecture", 1st edition, Elsevier Publications.

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Optional Elective - V

DIGITAL CONTROL SYSTEMS

III Year – II Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts on digital control systems and their associated components.
- To impart knowledge on z–transformations for the analysis of digital control systems.
- To familiarize with the concepts on state model representation of discrete–time systems and its stability testing methods.
- To impart knowledge on design of state feedback controller using pole placement method.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- specify the components of digital control systems.
- employ z–transformations to analyze digital control systems
- assess the stability of digital systems and suggest methods to improve stability margins.
- employ the state–space representation for the analysis and design of digital systems.

Course Content

UNIT - I: Introduction and Signal Processing

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Signals and processing – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT - II: Z–Transformations

Z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT - III: State Space Analysis and the Concepts of Controllability and Observability

State Space Representation of discrete time systems – State transition matrix and Electrical and Electronics Engineering 182 methods of evaluation – Discretization of continuous – Time state equations – Concepts of controllability and observability – Tests (without proof).

UNIT - IV: Stability Analysis

Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips – Stability criterion – Modified routh's stability criterion and jury's stability test.

UNIT - V: Design of Discrete–Time Control Systems by Conventional Methods

Transient and steady state specifications – Design using frequency response in the w–plane for lag and led compensators – Root locus technique in the z– plane.

UNIT - VI: State Feedback Controllers

Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

Text Books

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.

Reference Books

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control and State Variable Methods by M.Gopal, TMH.

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Professional Elective - III

MACHINE LEARNING

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the field of machine learning, in particular focusing on the core concepts of supervised learning.
- To familiarize with different types of learning algorithms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe the features of a learning system.
- apply Find-S and Candidate-elimination algorithms to solve problems of moderate complexity.
- demonstrate different types of neural networks and their representation.
- calculate posterior probabilities using Bayes theorem.
- differentiate lazy and eager learning algorithms along with their strengths and weaknesses.
- Illustrate the use of genetic algorithms in machine learning.

Course Content

UNIT - I: Introduction

Well- posed learning problems, designing a learning system, perspectives and issues in machine learning.

UNIT - II: Concept learning and the General to Specific Ordering

Introduction, a concept learning task, concept learning as search, find-s: finding a maximally specific hypothesis, version spaces and the candidate-elimination algorithm, remarks on version spaces and candidate-elimination.

UNIT - III: Bayesian Learning

Introduction, Bayes theorem, maximum likelihood and least-squared error hypotheses, minimum description length principle, Bayes optimal classifier, Naive Bayes Classifier, Bayesian belief networks.

UNIT - IV: Artificial Neural Networks

Introduction, neural network representation, appropriate problems for neural network learning, perceptrons – representational power of perceptrons, the perceptron training rule, gradient descent and the delta rule; multilayer networks and the back propagation algorithm – the differential threshold unit, the back propagation Algorithm.

UNIT -V: Instance-Based Learning

Introduction, k-nearest neighbour learning, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

UNIT - VI: Genetic Algorithms

Motivation, genetic algorithms, genetic programming.

Text Books

1. Tom M. Mitchell, "Machine Learning", MGH.
2. Peter Harrington, "Machine Learning in Action", Manning Publications.

Reference Books

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd edition, PHI.
2. Jason Bell, "Machine Learning: Hands-On for Developers and Technical Professionals", Wiley.

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Professional Elective - III

INTERNET OF THINGS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the fundamentals of Internet of Things.
- To familiarize with the building of small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the basic concepts of Internet of Things.
- analyze the requirements and specifications to design home automation applications.
- develop smart city applications using Arduino IoT kit.
- design agricultural applications using Raspberry Pi IoT kit.
- use the tools such as AutoBahn, Xively Cloud communication API's to exchange data between cloud and IoT kit.
- analyze Home automation, Agriculture, Smart city applications.

Course Content

UNIT - I: Fundamentals of IoT

Introduction, characteristics, physical design, protocols, logical design, enabling technologies, IoT levels and deployment templates, M2M, IoT vs M2M.

UNIT - II: IoT Design Methodology

IoT Design Methodology: Purpose and requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specification, functional view specification, operational view specification, device and component integration, application development.

UNIT - III: Prototyping Embedded Device with Arduino

Sensors, Actuators, Embedded computing basics: Micro controllers, System on Chips, choosing your platform, Arduino: Developing on the Arduino.

UNIT - IV: Prototyping Embedded Device with Raspberry Pi

Raspberry Pi: Introduction, cases and extension boards, developing on the Raspberry Pi.

UNIT - V: IoT Physical Servers & Cloud Offerings

Introduction to cloud storage, Models and communication APIs, WAMP, AutoBahn for IoT, Xively cloud for IoT, Python web application framework: Django.

UNIT - VI: Domain Specific Applications of IoT

Home Automation, Agriculture Applications, Smart City applications.

Text Books

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press.
2. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley & Sons.

Reference Books

1. Marco Schwartz, "Internet of Things with the Arduino Yun", PACKT Publishing.
2. Manoel Carlos Ramon, "Intel Galileo and Intel Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress.
3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley.

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Professional Elective - III

NoSQL DATABASES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with various NoSQL Databases to handle structured, semi-structured and unstructured data

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the need of NoSQL Databases.
- compare different NoSQL Databases such as Document-Oriented, Key-Value Pairs, Column-Oriented and Graph Databases.
- categorize NoSQL Databases using CAP theorem.
- apply create, report, update, and delete (CRUD) operations on NoSQL databases.
- create NoSQL databases using MongoDB, Cassandra, Neo4J and Redis/Riak.
- analyze NoSQL database strengths and weaknesses.

Course Content

UNIT - I: Introduction

Overview and history of NoSQL databases, the value of relational databases, getting at persistent data, concurrency, integration, impedance mismatch, application and integration databases, the emergence of NoSQL, NoSQL database properties (CAP Theorem).

UNIT - II: Aggregate Data Models

Aggregates, key-value and document data models, column-family stores, graph databases, NoSQL database strengths and weaknesses.

UNIT - III: Key-Value databases

What is key-value store? key-value store features, suitable use cases- storing session information, user profiles, shopping cart data, key-value database using redis/riak.

UNIT - IV: Document Databases

What is a document database? features, suitable use cases- event logging, blogging platforms, web analytics or real-time analytics, e-commerce applications, document databases using MongoDB.

UNIT - V: Column-Family Stores

What is a column-family data store? features, suitable use cases- event logging, content management systems, counters, expiring usage, column-oriented NoSQL databases using Apache Cassandra.

UNIT - VI: Graph Databases

What is a graph database? features, suitable use cases- connected data, routing, dispatch, and location-based services, recommendation engines, graph NoSQL databases using Neo4J.

Text Book

1. Pramod J Sadalage, Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison Wesley.

Reference Books

1. Eric Redmond, Jim R Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st edition.
2. Dan Sullivan, "NoSQL for Mere Mortals", 1st edition, Addison Wesley.

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Professional Elective - III

SOFTWARE REQUIREMENTS ENGINEERING AND ESTIMATION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on good practices for requirements engineering, Requirements elicitation, elicitation techniques,
- To familiarize knowledge on analysis models, Software quality attributes, software estimation, size estimation, Effort, Schedule and Cost Estimation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- gain knowledge about software requirements.
- analyze requirement elicitation techniques and prototyping.
- gain knowledge about requirement management, their principles and practices.
- analyze use case modeling and different data diagrams.
- estimating the software in terms of size, cost, effort and schedule.

Course Content

UNIT - I: Software Requirements

Essential Software requirement, Good practices for requirements engineering, Improving requirements processes, Software requirements and risk management. Software Requirements Engineering: Requirements elicitation, requirements analysis documentation, review, elicitation techniques, analysis models, Software quality attributes, risk reduction through prototyping, setting requirements priorities, verifying requirements quality.

UNIT - II: Software Requirements Management

Requirements management Principles and practices, Requirements attributes, Change Management Process, Requirements Traceability Matrix, Links in requirements chain.

UNIT - III: Software Estimation

Components of Software Estimations, Estimation methods, Problems associated with estimation, Key project factors that influence estimation.

Size Estimation: Two views of sizing, Function Point Analysis, Mark II FPA, Full Function Points, LOC Estimation, Conversion between size measures.

UNIT - IV: Effort, Schedule and Cost Estimation

What is Productivity? Estimation Factors, Approaches to Effort and Schedule Estimation, COCOMO II, Putnam Estimation Model, Algorithmic models, Cost Estimation.

UNIT - V: Tools for Requirements Management

Benefits of using a requirements management tool, commercial requirements management tool, Rational Requisite pro, Caliber – RM, implementing requirements management automation.

UNIT - VI: Software Estimation Tools

Desirable features in software estimation tools, IFPUG, USC's COCOMO II, SLIM (Software Life Cycle Management) Tools.

Text Book

1. Swapna Kishore, Rajesh Naik, "Software Requirements and Estimation", 1st edition, Tata Mc Graw Hill.

Reference Book

1. Karl E. Wiegers, "Software Requirements", 2nd edition, Microsoft Press.

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Professional Elective - IV

MOBILE COMPUTING
(Common to CSE & IT)
IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of mobile computing paradigm, GSM, and various layers of mobile networks.
- To introduce the database issues, data delivery models, ad hoc networks platforms and protocols used in mobile environment.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain mobile computing paradigm, GSM, and layers of mobile networks.
- outline the mobile IP and Dynamic Host Configuration Protocol in network layer.
- describe the different TCP's and transmission mechanisms in transport layer.
- llustrate Data Dissemination and Synchronization models for applications.
- synthesize MANET applications and routing algorithms with security mechanisms.
- summarize the layers and functionalities in wireless application protocol and Bluetooth.

Course Content

UNIT - I: Introduction

Introduction to MC, novel applications, limitations, and architecture.

GSM-Mobile services, system architecture, radio interface, protocols, localization and calling, handover, security, and new data services.

[UNIT - II: Mobile Network Layer

Mobile IP (goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).

UNIT - III: Mobile Transport Layer

Traditional TCP, indirect TCP, snooping TCP, mobile TCP, fast retransmit/fast recovery, transmission /time-out freezing, selective retransmission, transaction oriented TCP.

UNIT - IV: Database Issues and Dissemination

Database Issues-Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues.

Data Dissemination-Communications asymmetry, Classification of new data delivery mechanisms.

UNIT - V: Mobile Adhoc Networks

Overview, properties of a MANET, spectrum of MANET applications, routing and algorithms, security in MANETs.

UNIT - VI: Protocols and Tools

Wireless Application Protocol-Introduction, protocol architecture, and treatment of protocols of all layers, Bluetooth-user scenarios, physical layer, MAC layer, networking, security, link management.

Text Books

1. Jochen Schiller,"Mobile Communications",2nd Edition, AddisonWesley.
2. Raj Kamal, "Mobile Computing", 2nd Edition, Oxford University Press.

Reference Books

1. Frank Adelstein, Sandeep KS Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing", McGraw-Hill.
2. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley.

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Professional Elective - IV

IMAGE PROCESSING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To disseminate knowledge on various image processing techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- use appropriate image enhancement technique to improve the quality of an image.
- apply suitable image segmentation technique for an application.
- analyze various image compression techniques.
- apply morphological operations to modify the structure of an image.

Course Content

UNIT - I: Introduction

Digital image processing, examples of fields that use digital image processing, fundamental steps in digital image processing

Digital image fundamentals- Image sensing and acquisition, sampling and quantization, basic relationships between pixels.

UNIT - II: Image Enhancement in the Spatial Domain

Introduction, Basic gray-level transformations, histogram processing, enhancement using arithmetic and logic operators. Basics of spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods.

UNIT - III: Color Image Processing

Introduction, color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transformations, color image smoothing and sharpening, color segmentation.

UNIT - IV: Image Compression

Fundamentals, image compression models, error-free compression, lossy predictive coding.

UNIT - V: Morphological Image Processing

Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms.

UNIT VI: Image Segmentation

Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation.

Text Books

1. Rafeal C. Gonzalez, Richard E.Woods, "Digital Image Processing", 2nd edition, Pearson Education.

Reference Books

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", 2nd edition, Thomson Learning.
2. Adrian Low, "Computer Vision and Image Processing", 2nd edition, McGraw-Hill.
3. William K. Pratt, "Digital Image Processing", 3rd edition, Wiley.
4. B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", 2nd edition, Prentice Hall of India.

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Professional Elective - IV

INFORMATION RETRIEVAL SYSTEMS

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce foundation knowledge in information retrieval.
- To familiarize about different applications of information retrieval techniques in the Internet or Web environment.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify basic theories in information retrieval systems.
- identify the analysis tools as they apply to information retrieval systems.
- understands the problems solved in current IR systems.
- describes the advantages of current IR systems.
- understand the difficulty of representing and retrieving documents.
- understand the latest technologies for linking, describing and searching the web.

Course Content

UNIT - I: Introduction to Information Storage and Retrieval System

Introduction, domain analysis of IR systems and other types of information systems, IR system evaluation. Introduction to Data Structures and Algorithms related to Information Retrieval: Basic concepts, Data structures, Algorithms.

UNIT - II: Inverted files

Introduction, structures used in inverted files, building inverted file using a sorted array, modifications to basic techniques.

UNIT - III: Signature Files

Introduction, concepts of signature files, compression, vertical partitioning, horizontal partitioning.

UNIT - IV: New Indices for Text

PAT Trees and PAT Arrays: Introduction, PAT Tree structure, algorithms on the PAT trees, building PAT trees as PATRICA trees, PAT representation as arrays.

UNIT - V: Stemming Algorithms

Introduction, types of stemming algorithms, experimental evaluations of stemming to compress inverted files.

UNIT - VI: Thesaurus Construction

Introduction, features of thesauri, thesaurus construction, thesaurus construction from texts, merging existing thesauri.

Text Books

1. William B. Frakes, Ricardo Baeza-Yates, "Information Retrieval: Data Structures and Algorithms", Prentice Hall.
2. Ricardo Baeza-Yates, Bertheir Ribeiro-Neto, "Modern Information Retrieval", Pearson Education.
3. Robert R. Korfhage, "Information Storage and Retrieval", John Wiley & Sons.

Reference Books

1. Gerald Kowalski, Mark T Maybury, "Information Storage and Retrieval Systems-Theory and Implementation", 2nd edition, Kluwer Academic Press.
2. David A. Grossman, Ophir Frieder, "Information Retrieval: Algorithms and Heuristics", 2nd edition, Springer.

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Professional Elective - IV

OPTIMIZATION TECHNIQUES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce how to formulate allocation problems as LPP, transportation problem and assign problems and locate solution.
- To familiarize with the concepts of queuing theory.
- To impart knowledge on game theory concepts and to apply basic mathematical concepts to game Problems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- formulate the problem as LPP and to find optimal solution.
- determine optimal distribution & optimal cost.
- find minimal sequence and total elapsed time.
- evaluate operating characteristics in queuing models.
- determine optimal strategies for players.

Course Content

UNIT - I: Linear Programming - I

Introduction to OR, definition, characteristics, modelling in OR-classification by structure, linear programming problem, formulation, solution by graphical method.

UNIT - II: Linear Programming - II

Standard form of LPP, simplex method, artificial variable technique, Big-m method, duality principle, rules to convert primal to dual.

UNIT - III: Transportation-Assignment Problems (Allocation Methods)

Transportation problem – balanced and unbalanced, finding IBFS-north west corner rule, matrix minima method, VAM, optimal solution-MODI Method, degeneracy.

Assignment problems-optimal solution by Hungarian method, special cases - unbalanced and maximal assignment problems, travelling sales man problem.

UNIT - IV: Job Sequencing

Introduction–types of sequencing problems-processing n jobs through two machines, processing n jobs through three machines and processing n jobs through m machines.

UNIT - V: Queuing Theory (Waiting line Theory)

Introduction, elements of queuing system, operating characteristics, Classification of queuing models: Single channel, Poisson arrivals, exponential service times with infinite and finite population capacity. Multi service channel with infinite queue size.

UNIT - VI: Game Theory

Introduction to game theory, two person zero sum games, Maximin - Minimax principle, solution of games with and without saddle points, dominance property and graphical solution of 2Xn and mX2 games.

Text Books

1. Kanthi Swarup, P.K.Gupta and Man Mohan, "Operations Research", 14^{th} edition, S. Chand & Sons.
2. S.D. Sharma, Himanshu Sharma, "Operations Research: Theory, Methods and Applications", 15^{th} edition, Kedar Nath Ram Nath, 2010.

Reference Books

1. Hamdy A. Taha, "Operations Research:An Introduction", 8^{th} edition, PHI Publications.
2. Billy E. Gillett, "Introduction to Operations Research: A Computer-oriented Algorithmic Approach", Tata McGraw-Hill.

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Optional Elective - VII

NETWORK PROGRAMMING

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basics of network Technologies.
- To impart in-depth knowledge in socket creation and client-server communication in TCP and UDP.
- To familiarize the importance of remote login and inter-process communication.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the requirements of a networked programming environment and identify the issues to be solved.
- develop client-server communication using TCP and UDP protocols by writing socket programming.
- interpret the basic network technologies and protocols usage by common internet application.
- apply theoretical principles and use appropriate functions for establishing client-server communication.
- classify different types of IPC mechanisms for communicating processes exist in the same system and in different systems.

Course Content

UNIT - I: Introduction to Network Programming

OSI model, UNIX standards, TCP and UDP and TCP connection establishment and termination, port numbers, TCP port numbers and concurrent servers, buffer sizes and limitation, protocol usage by common internet application.

UNIT - II: Sockets

Address structures, value–result arguments, byte ordering and manipulation functions. Elementary TCP sockets–socket, connect, bind, listen, accept, fork function, concurrent servers.

UNIT - III: TCP Client-Server

Introduction, TCP echo server functions, normal startup, termination, POSIX signal handling, termination of server process, crashing and rebooting of server host, shutdown of server host.

UNIT - IV: I/O Multiplexing and Socket Options

I/O models, select function, poll function, TCP echo server, getsockopt and setsockopt functions.

UNIT - V: Elementary UDP Sockets

Introduction, UDP echo server function, lost datagrams, UDP example, lack of flow control with UDP.

UNIT - VI: Elementary name and Address Conversions

DNS, gethostbyName function, gethostbyaddr function.

IPC: Pipes, FIFOs, message queues.

Text Books

1. W.Richard Stevens, Bill Fenner, Andrew M. Rudoff, "UNIX Network Programming: The Sockets Networking API", Volume 1, 3rd edition, Addison-Wesley.
2. W. Richard Stevens, "UNIX Network Programming", 1st edition, PHI.

Reference Books

1. Graham Glass, King Ables, "UNIX for Programmers and Users", 3rd edition, Pearson Education.
2. Marc. J. Rochkind, "Advanced UNIX Programming", 2nd edition, Pearson Education.

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Optional Elective - VII

SYSTEMS SOFTWARE

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the implementation details of assemblers, loaders, linkers, and macro processors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the relationship between system software and machine rchitecture.
- analyze working of assembler for a simplified Instructional computer.
- describe the important features of linkage Editors and Dynamic Linking.
- identify the mostly used macro processors algorithms and data structures.
- compare the functions of Absolute Loader , Bootstrap Loaders.

Course Content

UNIT - I: Introduction

System software and machine architecture, The Simplified Instructional Computer (SIC), Machine architecture, Data and instruction formats, addressing modes, instruction sets, I/O and programming System.

UNIT - II: Assemblers

Basic assembler functions, SIC assembler, assembler algorithm and data structures, machine dependent assembler features.

UNIT - III: Implementation of Assemblers

Instruction formats and addressing modes, program relocation, machine independent assembler features, literals, symbol, defining statements, expressions, one pass assemblers, multi pass assemblers, implementation example, MASM assemble.

UNIT - IV: Loaders

Basic loader functions, design of an absolute loader, simple bootstrap loader, machine dependent loader features, relocation, loader options, loader design options, bootstrap loaders.

UNIT - V: Linkers

Program linking, algorithm and data structures for linking loader, machine independent loader features, automatic library search, linkage editors, dynamic linking, implementation example, MS DOS linkers.

UNIT - VI: Macro Processors

Basic macro processor functions, macro definition and expansion, macro processor algorithm and data structures, machine independent macro processor features, concatenation of macro parameters, generation of unique labels, conditional macro expansion.

Text Books

1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia.

Reference Books

1. D. M. Dhamdhere, "Systems Programming and Operating Systems", 2nd Revised Edition, Tata McGraw-Hill.
2. John J. Donovan "Systems Programming", Tata McGraw-Hill Edition.

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Optional Elective - VII

ROBOTICS

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with anatomy, kinematics, sensors and dynamics of a programmable machine, robot.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between fixed automation and programmable automation.
- identify various components of robot.
- select appropriate type of actuator for a joint.
- illustrate robot applications in manufacturing.
- analyze kinematics of a robot.
- develop equations of motion of a manipulator for a given application.
- create a trajectory plan for execution of a work cycle.

Course Content

UNIT - I:

Introduction: Automation and Robotics, Components of Robot – Mechanical manipulator-control system and end effectors-Types of end effectors — Requirements and challenges of end effectors classification of robots by coordinate system and control system. Control resolution, accuracy, repeatability and work volume of robot.

UNIT - II:

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric &

stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocitysensors.

UNIT - III:

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing operations - spot and continuous arc welding & spray painting - Assembly and Inspection.

Future applications of robots.

UNIT - IV:

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – Problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT - V:

Differential transformations and manipulator Jacobian – Problems,

Dynamics: significance of dynamic modelling of a robot, Lagrange – Euler formulation- LE formulation for inverted pendulum and two degree of freedom RR manipulator

Newton – Euler formulation –basic treatment.

UNIT - VI:

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint integrated motion

straight line motion – Robot programming, lead through programming and textual language programming.

Text Books

1. Groover M P ,"Industrial Robotics", TMH.
2. Mittal R K &Nagrath I J,"Robotics and Control", TMH.

Reference Books

1. Richard D. Klafter,"Robotic Engineering", Prentice Hall.
2. P. Coiffet and M. Chaironze,"An Introduction to Robot Technology", Kogam Page Ltd. 1983 London.
3. Asada,"Robot Analysis and Intelligence", Wiley Inter-Science.
4. John J Craig ,"Introduction to Robotics",Pearson Edu.
5. Mark W. Spong and M. Vidyasagar,"Robot Dynamics &Control",John Wiley & Sons (ASIA) Pvt Ltd.

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Professional Elective - V

WEB MINING

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart machine learning techniques to mine the web and other information networks like social networks and social media.
- To introduce search, retrieval, classification and recommendation methods.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe classic and recent developments in information retrieval, web search and web mining
- apply Page Rank and HITS algorithm for social network data analysis
- differentiate Universal, Focused and Topical crawlers in internet
- analyze complex information and social networks using Information Integration techniques
- discover sentiment from social media data using opinion mining and web usage mining.

Course Content

UNIT - I: Information Retrieval and Web Search

Basic concepts of information retrieval, IR models, text and web page pre-processing, inverted index and its compression, web search, meta-search.

UNIT - II: Link Analysis

Social network analysis, page rank algorithm, HITS algorithm, community discovery.

UNIT - III: Web Crawling

Crawler algorithm, implementation issues, universal crawlers, focused crawlers, topical crawlers.

UNIT - IV: Information Integration

Schema matching, pre-processing, schema level match, domain and instance level match, 1: m match, integration of web query interfaces.

UNIT - V: Opining Mining

Sentiment classification, feature based opinion mining, comparative sentence and relation mining, opinion search.

UNIT - VI: Web Usage Mining

Data collection, data modelling for web usage mining, discovery and analysis.

Text Books

1. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data", Springer Science & Business Media.
2. Charu C. Aggarwal, "Social Network Data Analytics", Springer Science & Business Media.

Reference Book

1. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer Science & Business Media.

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Professional Elective - V

CLOUD COMPUTING
(Common to CSE & IT)
IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide the architectural concepts of Cloud computing.
- To familiarize with cloud service models and cloud based applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- differentiate the stages in historical evolution of cloud computing.
- use suitable cloud services to define cloud for the enterprise.
- demonstrate hardware level and OS level virtualization to implement virtual machines.
- design machine images, web applications and databases for virtual machines.
- apply data, network and host security for the cloud.

Course Content

UNIT - I: Cloud Computing

Introduction, cloud computing: What it is and what it isn't, from collaboration to the cloud : A short history of cloud computing, the network is the computer: How cloud computing works, understanding cloud architecture , storage, services; The pros and cons of cloud computing. Who benefits from cloud computing? who shouldn't be using cloud computing.

UNIT - II: Defining Clouds for the Enterprise

Storage-as-a-Service, Database-as-a-Service, Information-as-a-Service, Process-as-a-Service, Application-as-a-Service, Platform-as-a-Service, Security-as-a-service, Infrastructure-as-a-Service.

UNIT - III: Virtual Machines and Virtualization

Implementation levels of virtualization: levels of virtualization implementation, VMM design requirements and providers, virtualization support at the OS level, virtualization structures/tools and mechanisms: Hypervisor and Xen architecture, binary transition with full virtualization, para-virtualization with compiler support.

UNIT - IV: Hardware Virtualization

Virtualization of CPU, memory and I/O devices: Hardware support for virtualization, CPU virtualization, memory virtualization, I/O virtualization.

UNIT - V: Ready for the cloud

Web application design, machine image design, privacy design, database management: clustering or replication? primary key management, database backups.

UNIT - VI: Security

Data Security: data control, encrypt everything, regulatory and standards compliance; Network Security: firewall rules, network intrusion detection; Host Security: system hardening, antivirus protection, host intrusion detection, data segmentation, credential management; Compromise response.

Text Books

1. Kai Hwang, Jack Dongarra and Geoffrey C.Fox, "Distributed and Cloud Computing:From Parallel Processing to the Internet of Things", 1st edition, Morgan Kaufman Publications.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", 1st edition, O'Reilly.

Reference Books

1. Michael Miller, "Cloud Computing- Web Based Applications That Change the Way You Work and Collaborate Online", 1st edition, Que publications.
2. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide" Addison Wesley.

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Professional Elective - V

AGILE SOFTWARE DEVELOPMENT PROCESS

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the important concepts of Agile software development Process
- To emphasize the role of stand-up meetings in software collaboration.
- To impart the knowledge on values and principles in understanding agility.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline Pair Programming for solving software problems
- write Reports of Software Collaboration.
- prepare less or zero bug software for sample scenario.
- reduce the amount of Slack in the software.
- develop methodologies for estimating performance stories.
- justify the waste elimination process in Software in mastering Agility.

Course Content

UNIT - I: Introduction

Introduction to agile, understanding XP - The XP lifecycle, The XP team, XP concepts. Thinking - pair programming, root-cause analysis.

UNIT - II: Planning

Product vision, release planning, the planning game, iteration planning, slack, stories, estimating.

UNIT - III: Collaborating

Trust, real customer involvement, ubiquitous language, stand-up meetings, iteration demo, reporting.

UNIT - IV: Developing

Incremental requirements, customer tests, test driven development, incremental design and architecture, performance optimization.

UNIT - V: Releasing

Production-ready software, no bugs, ten-minute build, continuous integration, collective code ownership, documentation.

UNIT - VI: Mastering Agility

Values and principles, improve the process, eliminate waste, deliver value, seek technical excellence.

Text Book

1. James Shore, Shane Warden, "The Art of Agile Development", OReilly.

Reference Books

1. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices", Prentice Hall/Pearson Education.
2. Alistair Cockburn, "Agile Software Development: The Cooperative Game", 2nd edition, Pearson Education.

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Professional Elective - V

BLOCKCHAIN TECHNOLOGIES
(Common to CSE & IT)
IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the fundamental concepts of Block Chain.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline fundamentals of Block chain.
- analyze the working of Block Chain.
- describe propelling business with block chains.
- illustrate Hyperledger and Linux Foundation Project, use cases.
- summarize challenges of Block chain

UNIT - I: Grasping Blockchain Fundamentals

Tracing Blockchain's Origin, The shortcomings of current transaction systems, the emergence of bitcoin, The birth of blockchain, Revolutionizing the Traditional Business Network, Exploring a blockchain application, Recognizing the key business benefits, Building trust with Blockchain.

UNIT - II: Taking a Look at How Blockchain Works

Why It's Called "Blockchain", What Makes a Blockchain Suitable for Business?, Shared ledger, Permissions, Consensus, Smart contracts ,Identifying Participants and Their Roles.

UNIT - III: Propelling Business with Blockchains

Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility.

UNIT - IV: Blockchain in Action: Use Cases

Financial Services, Commercial financing, Trade finance, Cross-border transactions, Insurance, Government, Supply Chain Management, Healthcare, Electronic medical records. Healthcare payments pre-authorization, The Internet of Things (IoT).

UNIT - V: Hyperledger, a Linux Foundation Project

Hyperledger Vision, Hyperledger Fabric, How Can IBM Help Developers Innovate With Blockchain: Offering an easily accessible cloud and development platform, individualized attention and industry expertise.

UNIT - VI: Challenges of Blockchain

Technical challenges, Business model challenges, scandals and public perception, government regulation, privacy challenges for personal records, decentralization trends likely to persist.

Text Book

1. Manav Gupta, "Blockchain For Dummies®", IBM Limited Edition, John Wiley & Sons, Inc.111 River St,Hoboken, NJ 07030-5774

Reference Book

1. Swan, Melanie, "Blockchain: Blueprint for a new economy", O'Reilly Media, Inc.", 2015.

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Professional Elective - VI

DISTRIBUTD SYSTEMS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of distributed computing systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- recognize the applications of distributed systems.
- describe important characteristics of distributed systems and the salient architectural features of such systems.
- develop a familiarity with distributed file systems.
- determine a strategy to overcome the effects of deadlocks.
- distinguish between active replication and passive replication.
- develop a familiarity with distributed file systems.
- estimate the working of various algorithms used to achieve synchronization.

Course Content

UNIT - I: Characterization of distributed Systems

Introduction, examples of distributed systems, resource sharing and the web, challenges.

System Models: introduction, architectural models- software layers, system architecture.

UNIT - II: Inter process Communication

Introduction, the API for the internet protocols- the characteristics of interprocess communication, sockets, UDP datagram communication, TCP stream communication; Client server communication; Group communication.

UNIT - III: Synchronization in Distributed Systems

Clock synchronization, mutual exclusion, election algorithms: Bully algorithm, ring algorithm, atomic transactions.

UNIT - IV: Deadlocks

Deadlocks in distributed systems, distributed deadlock prevention, and distributed deadlock detection.

UNIT - V: File Systems, Coordination and Agreement

Distributed file systems: Introduction, file service architecture; Peer-to-Peer systems: Introduction, peer-to-peer middleware.

Coordination and Agreement: Introduction, distributed mutual exclusion, elections.

UNIT - VI: Transactions and Replications

Introduction, system model and group communication, replication-introduction, passive (primary) replication, active replication.

Text Books

1. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems:Concepts and Design", 2nd edition, Pearson.

Reference Book

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems Principles and Paradigms", 2nd edition, Pearson Prentice Hall.

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Professional Elective - VI

SOCIAL NETWORKS

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with technological concepts of social networks.
- To provide a comprehensive overview of social network systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline social network concepts
- categorize network segments and their characteristics.
- analyze psychological foundations of social networks.
- evaluate network structure of organizations.
- examine network influence and diffusion of ideas.
- evaluate network as social capital.

Course Content

UNIT - I: Basic Social Network Concepts

Network, sociological questions about relationships, dyads and mutuality and balance and triads-distributions-dyads and triads, density, structural holes, weak ties, popularity or centrality, distance, size of interpersonal environment and the small world-multiplexity-role multiplexity and content multiplexity-roles and positions-named positions and relationships and informal relations and hierarchies-embedded of the informal within instituted or named networks.

UNIT - II: Network Segmentation

Named and unnamed network segments and primary groups, cliques and clusters-segmenting networks from the point of view of observer-segmenting networks on the basis of cohesion, resistance to disruption, structural similarity and structural equivalence and core/periphery structures.

UNIT - III: Psychological Foundations of Social Networks

Community and support, safety and affiliation-effectiveness and structural holes-safety and social networks, effectiveness and social networks, both safety and effectiveness-driving for status or rank, cultural differences in safety, effectance and rank, cognitive limits on individual networks.

UNIT - IV: Organizations and Networks Information

The contradictions of authority, emergent networks in organization, factory floor and information driven organizations, bridging the gaps: Tradeoffs between network size, diversity and social cohesion.

UNIT – V: Networks Influence and diffusion

The basic model, influence and decision making, epidemiology and network diffusion.

UNIT - VI: Network as Social Capital

Individual level social capital, social capital as an attribute of social systems.

Text Books

1. Charles Kadushin, "Understanding Social Networks: Theories, Concepts, and Findings" Oxford University Press.

Reference Books

1. Peter Mika, "Social Networks and the Semantic Web", Springer Science & Business Media.
2. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications", Cambridge University Press.

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Professional Elective - VI

WEB SERVICES

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce knowledge about various web services available and their architectures.
- To impart WSDL tools, SOAP and UDDI architecture models in designing web service applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- differentiate various distributed computing technologies
- identify the emergence of web services in service oriented architecture.
- develop web service applications using WSDL tools
- use SOAP and UDDI architectures in designing Web service applications.
- apply XML encryption and XML digital signature methods for providing security to the web service enabled applications.

Course Content

UNIT - I: Evolution and Emergence of Web Services

Evolution of distributed computing, core distributed computing technologies- client/ server architecture, CORBA, JAVA RMI, MicroSoft DCOM, MOM, challenges in distributed computing, role of J2EE and XML in distributed computing, need of Service Oriented Architecture (SOA).

UNIT - II: Introduction to Web Services

Web services architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services, developing web services enabled applications.

UNIT - III: Describing Web Services WSDL

WSDL in the world of web services, web services life cycle, anatomy of WSDL definition document, WSDL bindings, WSDL tools, limitations of WSDL.

UNIT - IV: Core Fundamentals of SOAP

SOAP message structure, SOAP encoding, SOAP message exchange models, SOAP communication and messaging, SOAP security, developing web services using SOAP, limitations of SOAP.

UNIT - V: Discovering Web Services

Services discovery, role of service discovery in a SOA, service discovery mechanisms, UDDI registries and their uses, UDDI data structures, support for categorization in UDDI registries, Operations on UDDI Registry: Publishing, searching, deleting information in a UDDI registry, limitations of UDDI.

UNIT - VI: Web Services Interoperability

Means of ensuring interoperability, Web services security: XML Security frame work, XML encryption, XML digital signature, XKMS structure, Guidelines for signing XML documents.

Text Books

1. R.Nagappan, R.Skoczylas, R.P.sriganesh, "Developing Java Web Services", Wiley India.
2. Mc Goven, Tyagi, Stevens, Mathew, "Java Web Services Architectures", Elsevier.
3. S. Chatterjee, J. Webber, "Developing Enterprise Web Services", Pearson Education.

Reference Books

1. S.Graham, et al., "Building Web Services with Java", 2nd edition, Pearson Education.
2. D. A. Chappell and T. Jewell, "Java Web Services", O'Reilly.

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Professional Elective - VI

DEEP LEARNING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide exposure to these advances and facilitate in depth discussions on deep learning.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand recent advances in feed forward networks.
- analyzed the recent advances in deep generative models.
- learn the recent advances in deep learning.
- recent advances in Deep Generative Models.

Course Content

UNIT - I: Machine Learning Basics

Learning algorithms, capacity, over fitting and under fitting, hyper parameters and validation sets , estimators, bias and variance , maximum likelihood ,estimation bayesian statistics supervised learning algorithms, unsupervised learning algorithms, stochastic gradient descent, building machine learning algorithm, challenges motivating deep learning.

UNIT - II: Deep Feedforward Networks

Example: Learning XOR, gradient-based learning, hidden units, architecture design, back-propagation and other differentiation algorithms.

UNIT - III: Regularization for Deep Learning

Parameter norm penalties, norm penalties as constrained optimization, regularization and under-constrained problems, dataset augmentation, noise robustness, semi-supervised learning, multitask learning.

UNIT - IV: Optimization for Training Deep Models

How learning differs from pure optimization, challenges in neural network optimization, basic algorithms, parameter initialization strategies, algorithms with adaptive learning rates, approximate second-order methods, optimization strategies and meta-algorithms.

UNIT - V: Convolutional Networks

The convolution operation, motivation, pooling, convolution and pooling as an infinitely strong prior, efficient convolution algorithms, random or unsupervised features, the neuroscientific basis for convolutional networks.

UNIT - VI: Sequence Modeling: Recurrent and Recursive Nets

Unfolding computational graphs, recurrent neural networks, bidirectional RNNS, deep recurrent networks, recursive neural networks, challenges of long-term dependencies, optimization for long-term dependencies, explicit memory.

Text Books

1. I. Goodfellow, Bengio Y., Courville A., "Deep learning", Volume 1, MIT Press.
2. François Duval, "Deep Learning for Beginners: Practical Guide with Python and Tensorflow", Data Science Series, CreateSpace Independent Publishers.

Reference Book

1. Sebastian Raschka, Vahid Mirjalili, "Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow", 2nd edition, Packt Publishers.

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Professional Elective - I

ARTIFICIAL INTELLIGENCE

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize the concepts of AI for representation of knowledge and problem solving.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify the problems that are amenable and can be solved by using AI techniques.
- analyse the problem solving and game playing techniques.
- specify the classical Artificial Intelligence algorithms, which are used to solve the heuristic search and game playing problems.
- apply the basic principles and algorithms of Artificial Intelligence to recognise, model and solve the state space search, knowledge representation and reasoning problems.
- formulate the Reasoning model and state the conclusion for the uncertainty problems using actions and their effects over the time.
- describe expert systems and their applications.

Course Content

UNIT - I: Introduction to Artificial Intelligence

Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, current trends in AI.

UNIT - II: Problem solving and game playing

State-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques-Hill climbing, iterative-deepening A*, problem reduction, constraint satisfaction.

Game playing:Introduction, game playing, Min-max algorithm, alpha-beta pruning.

UNIT - III: Logic Concepts

Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution in proportional logic, resolution in predicate logic and unification algorithm.

UNIT - IV: Knowledge representation

Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames.

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure.

UNIT - V: Reasoning in Uncertain Situations

Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Classical planning problem: Goal stack, hierarchical planning.

UNIT - VI: Expert system and applications

Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, blackboard systems, Model-Based Expert System, Case- Based Expert System and Hybrid Expert System and application of expert systems.

Text Books

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", 2nd Edition Tata McGraw Hill Education.
2. Stuart J. Russell, "Artificial Intelligence: A Modern Approach", 2nd Edition.

Reference Books

1. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition, Pearson Education.
2. Russel and Norvig, "Artificial Intelligence", 3rd Edition, Pearson Education/ PHI.
3. Patterson, "Introduction to Artificial Intelligence and Expert Systems", 2nd Edition, PHI publications.

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Professional Elective - I

EMBEDDED SYSTEM DESIGN

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts of embedded system design and to show how such systems are developed using a concrete platform built around.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between the general computing system and the embedded system.
- differentiate general purpose processors and single purpose processors.
- model different state machines and concurrent process.
- specify different design technologies of software and hardware design.

Course Content

UNIT - I: Introduction

Embedded System-definition, classification, application areas and purpose of embedded systems. The typical embedded system-core of the embedded system, memory, sensors and actuators, communication interface, embedded firmware.

Design challenge-optimizing design metrics, processor technology, IC technology, design technology.

UNIT - II: Single Purpose Processors

RT-level combinational logic, sequential logic (RTlevel), custom single purpose processor design (RT-level), optimizing custom single purpose processors.

UNIT - III:General Purpose Processors

Basic architecture, operation, pipelining, programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs) – MicroControllers and Digital Signal Processors.

UNIT - IV: State Machine and Concurrent Process Models

Introduction, models Vs languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM), concurrent process model.

UNIT - V: Interfacing

Communication basics, arbitration, Multilevel Bus Architectures, Advanced Communication Principles

UNIT - VI: Design Technology

Automation: Synthesis- parallel evolution of compilation and synthesis, synthesis levels, logic synthesis, RT synthesis, behavioral Synthesis, systems synthesis and Hardware/ Software Co-Design, verification: Hardware/Software co-simulation.

Text Books

1. Frank Vahid, Tony D. Givargis, "Embedded System Design - A Unified Hardware/Software Introduction",John Wiley, 2002. (Unit II to VI).
2. Shibu.K.V , "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited (Unit I).

Reference Books

1. Raj kamal, "Embedded Systems", 2nd Edition, 2008, TMH.
2. Tammy Noergaard, "Embedded Systems Architecture", 1st Edition, 2005, Elsevier Publications.

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Professional Elective - I

COMPUTER GRAPHICS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce computer graphics applications and functionalities of various graphic systems.
- To familiarize with 2D and 3D geometrical transformations.
- To disseminate knowledge on the visible surface detection and animation.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- design a conceptual model for the mathematical model to determine the set of pixels to turn on for displaying an object.
- analyze the functionalities of various display devices and visible surface detection methods.
- analyze the performance of different algorithms to draw different shapes.
- choose different transformations and viewing functions on objects.
- apply raster animations for Engine oil advertisements.

Course Content

UNIT- I: Introduction

Introduction: Application of computer graphics, raster scan and random scan Displays.

Filled Area Primitives: Points and lines, inside and outside tests, line drawing algorithms, Scan line polygon fill algorithm.

UNIT- II: 2-D Geometrical Transforms

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transformations.

UNIT- III: 2D Viewing

The viewing pipeline, window to view-port coordinate transformation, Cohen-Sutherland line clipping algorithm, Sutherland –Hodgeman polygon clipping algorithm.

UNIT -IV: 3D Geometric Transformations

Translation, rotation, scaling, reflection and shear transformations, composite transformations, Types of projections.

UNIT- V: Visible Surface Detection Methods

Classification – types, back-face detection, depth-buffer, BSP tree, area sub-division method.

UNIT -VI: Computer Animation

Animations: General computer animation, raster animation, keyframe systems, Graphics programming using OpenGL: Basic graphics primitives, drawing three dimensional objects, drawing three dimensional scenes.

Text Books

1. Donald Hearn, M.Pauline Baker, "Computer Graphics *C* version", 2nd edition, Pearson Education.
2. Francis S. Hill, Stephen M. Kelley, "Computer Graphics using OpenGL", 3rd edition, Pearson Education.

Reference Books

1. Foley, VanDam, Feiner, Hughes, "Computer Graphics Principles and Practice", 2nd edition, Pearson Education.
2. Rajesh K Maurya, "Computer Graphics with Virtual Reality Systems", Wiley.

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Professional Elective - I

ADVANCED DATA STRUCTURES
(Common to CSE & IT)
III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce dictionaries, priority queue and balanced trees.
- To disseminate knowledge on Pattern Matching Algorithms and Tries.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- illustrate representations of sets and operations on sets and dictionaries.
- construct Priority queues such as min heap and max heap for the given data.
- create AVL, Red Black, Splay, B and B+ Trees for the given data and perform insertion, deletion and search operations on them.
- search for a pattern in the given text using Pattern Matching Techniques.
- demonstrate insertion and search operations on tries and also list its applications.

Course Content

UNIT - I: Sets and Dictionaries

Sets: Definition, set representation techniques, set operations.

Dictionaries: Definition, operations, ADT for dictionary, representation of dictionaries, applications of dictionaries.

UNIT - II: Priority Queues

Introduction, types of priority queues, implementation methods of priority queues, binary heap: min heap and max heap, applications of heap.

UNIT - III: Balanced Trees-1

AVL Trees: introduction, maximum height of an AVL tree, insertion and deletion operations.

UNIT - III: Balanced Trees-2

Red Black Trees - insertion and deletion operations, splay trees- insertion and deletion operations.

UNIT - IV: B and B+ Trees

B Trees - insertion and deletion operations, B+ trees- insertion and deletion operations.

UNIT - V: Pattern Matching

Introduction, pattern matching algorithms- the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, applications of pattern matching.

UNIT - VI: Tries

Introduction, advantages of tries, digital search tree, binary trie, compressed binary trie, patricia, multi way trie.

Text Books

1. Horowitz, Sahni, Anderson Freed, "Fundamentals of Data Structure in C", 2nd edition, University Press.
2. Richard F, Gilberg, Forouzan, "Data Structures", 2nd edition, Cengage.

Reference Books

1. Mark Allen Weiss, "Data structures and Algorithm Analysis in C", Pearson, 2nd edition.
2. Debasis Samanta, "Classic Data Structures", PHI, 2nd edition.

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Optional Elective - III

OBJECT ORIENTED PROGRAMMING THROUGH C++

III Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the concepts of Object oriented programming using C++

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the basic object oriented features.
- develop object oriented programs using C++.
- develop code to handle polymorphism, inheritance and exceptions.
- Implement templates in C++.

Course Content

UNIT - I: Introduction to Object-Oriented Programming and C++

Need of Object-Oriented Programming - Comparison of procedural, programming and Object-Oriented Programming.

C++ Programming Basics: Basic Program Construction, Data Types, Variables, Constants, Type Conversion, Operators, Loops and Decisions, Arrays – Strings. Structures,

UNIT - II: Features of Object-Oriented Programming

Introduction to Classes and Objects, Constructors: Parameterized constructors, Multiple constructors in a class Constructors With Default Arguments, Copy Constructors, Destructors.

UNIT - III: Polymorphism

Functions –Simple Functions, Inline Functions, Passing arguments, Recursion, Passing Objects as Function arguments and Returning Objects from Functions, Operator Overloading, Overloading Member Functions, Pointers, Virtual Functions – Friend Functions.

UNIT - IV: Inheritance

Introduction, Reusability, Access Specifiers and Simple Inheritance, Types of Inheritances(Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance).

UNIT - V: Exception Handling

Introduction, Principles of Exception Handling, The Keywords Try, Throw and Catch , Exception Handling Mechanism, Multiple Catch Statements, Catching Multiple Exceptions.

UNIT - VI: Generic Programming with Templates

Introduction, Need of Template, Definition of Class Template, Normal Function Template, Working of Function Templates, Class Template With More Parameters, Functions Templates With More Arguments.

Text Books

1. Herbert Schildt ,"The Complete Reference C++" 4^{th} ed, TMH.
2. E Balagurusamy "Object Oriented Programming with C++", 3^{rd} edition, TMH, 2007.

Reference Books

1. Robert Lafore, "Object-Oriented Programming in C++", 4th edition, SAMS Publishing, 2008
2. Deitel, "C++ How to Program", 6th edition, PHI publication, 2008.

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Optional Elective - III

DATA COMMUNICATION

III Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce various analog and digital modulation and demodulation techniques.
- To familiarize with various multiplexing schemes and Data communication protocols.
- To impart the standards and mechanisms of television systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the concepts of various analog and digital modulation techniques.
- analyze transmission mechanism in transmission lines and optical fiber.
- compare different multiplexing techniques.
- understand the principles of wireless communication systems.
- differentiate the different telephone systems.
- ascertain error detection and correction capabilities of various codes.

Course Content

UNIT - I: Signals, Noise, Modulation and Demodulation

Signal Analysis, Electrical Noise and Signal-to-Noise Ratio, Analog Modulation Systems, Information Capacity, Bits, Bit Rate, Baud, and M-ary Encoding, Digital Modulation.

UNIT - II: Metallic Cable Transmission Media

Metallic Transmission Lines, Transverse Electromagnetic Waves, Characteristics of Electromagnetic Waves

Optical Fiber Transmission Media: Advantages of Optical Fiber cables, Disadvantages of Optical Fiber Cables, Electromagnetic spectrum, Optical Fiber Communications System Block Diagram, Propagation of Light Through an Optical fiber Cable, Optical Fiber Comparison.

UNIT - III: Digital Transmission

Pulse Modulation, Pulse code Modulation, Dynamic Range, Signal Voltage to-Quantization Noise Voltage Ratio, Linear Versus Nonlinear PCM Codes, Companding, Delta Modulation, Differential PCM.

UNIT - IV: Wireless Communications Systems

Electromagnetic Polarization, Electromagnetic Radiation, Optical Properties of Radio Waves, Terrestrial Propagation of Electromagnetic Waves, Skip Distance, Free-Space Path Loss, Microwave Communications Systems, Satellite Communications Systems.

UNIT - V: Telephone Instruments And Signals

The Subscriber Loop, Standard Telephone Set, Basic Telephone Call Procedures, Call Progress Tones and Signals, Cordless Telephones, Caller ID, Electronic Telephones, Paging systems.

Cellular Telephone Systems: First- Generation Analog Cellular Telephone, Personal Communications system, Second-Generation Cellular Telephone Systems, Digital Cellular Telephone, Global system for Mobile Communications.

UNIT - VI: Data Communications Codes, Error Control And Data Formats

Data Communications Character Codes, Bar Codes, Error Control, Error Detection and Correction, Character Synchronization.

Text Books

1. Wayne Tomasi "Introduction to Data Communications and Networking", Pearson Education.
2. Behrouz A Forouzan "Data Communications and Networking", 4^{th} Edition. TMH.

Reference Books

1. William Stallings "Data and Computer communications", 8^{th} Edition, PHI.
2. Gallow "Computer Communications and Networking Technologies", 2^{nd} Edition.
3. Fred Halsll, Lingana Gouda Kulkarni "Computer Networking and Internet", 5^{th} Edition, Pearson Education.

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Optional Elective - III

BUILDING INFORMATION MODELING

III Year – I Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To understand the importance of BIM in Architecture, Engineering and Construction (AEC) industry
- To introduce BIM tools and need of parametric modeling
- To identify the use of BIM with Owners, Facility Managers, Architects, Engineers and contractors.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- apply the knowledge of inefficiencies with 2D and advantages of 3D modelling
- make use of BIM tools for model designing.
- adopt BIM towards risk identification.
- apprise the advantages and applications of BIM for designers and engineers
- provide the scope and guidance of BIM for contractors and suppliers.
- acknowledge wide use of BIM enabled processes for fabrications.

Course Content

UNIT - I :Introduction

The current (Architecture, Engineering and Construction) AEC business model, Documented inefficiencies of traditional approaches, BIM: New Tools and New Processes,

UNIT - II : Bim Tools & Parametric Modelling

The Evolution of object –based parametric modelling, BIM Environments, platforms and tools, Major BIM Design platforms,

Interoperability- different kinds of exchange formats, the evolution from file-Based exchange to building

UNIT - III: BIM for Owners and Facility Managers

BIM application areas for owners, tool guide for owners, Owner and Facility Manager's

Building model, Barriers to Implementing BIM: Risks and Common Myths, Guidelines and Issues for Owners to Consider when Adopting BIM.

UNIT - IV: BIM FOR ARCHITECTS AND ENGINEERS

Scope of design services, use in design processes, building object models and libraries, considerations in adoption for design practices.

UNIT - V: BIM FOR CONTRACTORS

Types of Construction Firms, Information Contractors Want from BIM, Processes to Develop a Contractor Building Information Model, Reduction of Design Errors Using Clash Detection, Quantity Takeoff and Cost Estimating, Construction Analysis and Planning, Integration with Cost and Schedule Control and Other Management Functions, Use of BIM Onsite: Verification, Guidance and Tracking of Construction Activities

UNIT - VI: BIM FOR SUBCONTRACTORS AND FABRICATORS

Types of Subcontractors and Fabricators, BIM-Enabled Process Change, Generic BIM System Requirements for Fabricators, Major Classes of Fabricators and Their Specific Needs, Adopting BIM in a Fabrication Operation

Text Books

1. BIM Handbook- A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors by Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, 4th edition, John Wiley & Sons Publications, Edition-2
2. BIM and Construction Management: Proven Tools, Methods, and Workflows, by Brad Hardin & Dave McCool, John Wiley & sons publications.

Reference Books

1. BIM for Construction Clients by Richard Saxon, RIBA Publishings, Edition-1
2. BIM Design: Realising the Creative Potential of Building Information Modelling by Richard Garber, John Wiley & sons publications.

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SOFT COMPUTING TECHNIQUES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To have a detailed study of neural networks, Fuzzy Logic and uses of Heuristics based on human experience.
- To familiarize with Soft computing concepts.
- To introduce the concepts of genetic algorithm and its applications to soft computing using some applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline soft computing techniques and its applications.
- classify the architecture of Artificial neural networks and learning techniques.
- interpret the working of Back propagation networks, back propagation algorithm and associative memory.
- differentiate fuzzy sets and crisp sets operations.
- apply if-then rules on fuzzy sets and perform Fuzzyfications & Defuzzifications.
- generalize the working principle, representations of genetic algorithm and its applications.

Course Content

UNIT - I: Introduction

Introduction to neural network human brain, models of a neuron, neural networks viewed as directed graphs, network architectures, knowledge representation, artificial intelligence and neural networks.

UNIT - II: Learning Process

Error correction learning, memory based learning, Hebbian learning, competitive, Boltzmann learning, credit assignment problem, memory, adaption, statistical nature of the learning process.

UNIT - III: Classical & Fuzzy Sets

Introduction to classical sets – properties, operations and relations; fuzzy sets – memberships, uncertainty, operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT - IV: Fuzzy Logic System Components

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT - V: Genetic Modeling

Cross over, Inversion and Deletion, Mutation operator, Bitwise operators, Generational cycle, Convergence of genetic algorithm.

UNIT - VI: Genetic Algorithms

Biological Background, Creation of offspring, Working principle, Encoding, Fitness function, Reproduction, Genetic Algorithms.

text Books

1. Simon Hhaykin, Neural networks A comprehensive foundations, 2nd edition, Pearson Education.
2. Rajasekharan and Pai, Neural Networks, Fuzzy Logic, Genetic Algorithms: Synthesis andApplications, PHI Publications

Reference Books

1. Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall, 1997.

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Professional Elective - II

REAL TIME SYSTEMS

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of Real – Time systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- make use of hard and soft real time systems.
- evaluate Clock driven scheduling, weighted round-robin, priority driven approaches in real time systems.
- compare rate monotonic and deadline monotonic algorithms.
- analyze multi task scheduling algorithms for periodic, aperiodic and sporadic tasks.
- demonstrate temporal distance and DCM.
- outline real time communications architecture.

Course Content

UNIT - I:

Introduction- Real time systems - Hard versus soft real time systems: hard real time systems and soft real-time systems.

UNIT - II:

Commonly used approaches to hard real-time scheduling- Clock driven scheduling, weighted round-robin, priority driven approach.

Clock - driven scheduling, scheduling sporadic jobs: Acceptance Test, EDF scheduling of accepted jobs, Algorithm for constructing static schedules.

UNIT - III:

Priority-driven scheduling of periodic tasks: Fixed Priority and Dynamic priority algorithms-Rate monotonic and Deadline monotonic algorithms.

UNIT - IV:

Resources and resource access control: Basic priority inheritance protocol-Definition, rules, and properties. Multiprocessor scheduling and resource access control and synchronization.

UNIT - V:

Scheduling flexible computations and tasks with temporal distance constraints-Algorithms for scheduling flexible application, Tasks with temporal distance constraints- temporal distance model.

UNIT - VI:

Real-Time Communications-architecture, real time connections and service disciplines-packet switched networks.

Text Books

1. Jane Liu, Real-Time Systems, Prentice Hall, 2000.
2. Philip.A.Laplante, Real Time System Design and Analysis, 3rd Edition, PHI, 2001.

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IMAGE PROCESSING

III Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To disseminate knowledge on various image processing techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- use appropriate image enhancement technique to improve the quality of an image.
- apply suitable image segmentation technique for an application.
- analyze various image compression techniques.
- apply morphological operations to modify the structure of an image.

Course Content

UNIT - I: Introduction

Digital image processing, examples of fields that use digital image processing, fundamental steps in digital image processing

Digital image fundamentals- Image sensing and acquisition, sampling and quantization, basic relationships between pixels.

UNIT - II: Image Enhancement in the Spatial Domain

Introduction, Basic gray-level transformations, histogram processing, enhancement using arithmetic and logic operators. Basics of spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods.

UNIT - III: Color Image Processing

Introduction, color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transformations, color image smoothing and sharpening, color segmentation.

UNIT - IV: Image Compression

Fundamentals, image compression models, error-free compression, lossy predictive coding.

UNIT - V: Morphological Image Processing

Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms.

UNIT VI: Image Segmentation

Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation.

Text Books

1. Rafeal C. Gonzalez, Richard E.Woods, "Digital Image Processing", 2nd edition, Pearson Education.

Reference Books

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", 2nd edition, Thomson Learning.
2. Adrian Low, "Computer Vision and Image Processing", 2nd edition, McGraw-Hill.
3. William K. Pratt, "Digital Image Processing", 3rd edition, Wiley.
4. B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", 2nd edition, Prentice Hall of India.

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Professional Elective - II

AGILE SOFTWARE DEVELOPMENT PROCESS

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the important concepts of Agile software development Process
- To emphasize the role of stand-up meetings in software collaboration.
- To impart the knowledge on values and principles in understanding agility.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline Pair Programming for solving software problems
- write Reports of Software Collaboration.
- prepare less or zero bug software for sample scenario.
- reduce the amount of slack in the software.
- develop methodologies for estimating performance stories.
- justify the waste elimination process in Software in mastering Agility.

Course Content

UNIT - I: Introduction

Introduction to agile, understanding XP - The XP lifecycle, The XP team, XP concepts. Thinking - pair programming, root-cause analysis.

UNIT - II: Planning

Product vision, release planning, the planning game, iteration planning, slack, stories, estimating.

UNIT - III: Collaborating

Trust, real customer involvement, ubiquitous language, stand-up meetings, iteration demo, reporting.

UNIT - IV: Developing

Incremental requirements, customer tests, test driven development, incremental design and architecture, performance optimization.

UNIT - V: Releasing

Production-ready software, no bugs, ten-minute build, continuous integration, collective code ownership, documentation.

UNIT - VI: Mastering Agility

Values and principles, improve the process, eliminate waste, deliver value, seek technical excellence.

Text Book

1. James Shore, Shane Warden, "The Art of Agile Development", OReilly.

Reference Books

1. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices", Prentice Hall/Pearson Education.
2. Alistair Cockburn, "Agile Software Development: The Cooperative Game", 2nd edition, Pearson Education.

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Optional Elective - V

SECURE WEB TECHNOLOGIES

III Year – II Semester

Lecture : -		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the concepts of securing web applications.
- To familiarize with different risks to web applications.
- To implement the steps required to mitigate those risks

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the basics and functionality of web application.
- contrast common web application security vulnerabilities.
- determine various injection attacks on web.
- describe cross site scripting formats.
- examine types of attacks on web.
- discuss various scripting languages to develop web applications.

Course Content

UNIT - I: Web Application Basics

Introduction, HTTP Protocol, Web Functionality, Encoding Schemes, Enumerating Content and Functionality, Analyzing the Application.

UNIT - II: Authentication Security

Authentication Techniques, Design Flaws in Authentication, Implementation Flaws in Authentication, Securing Authentication, Path Traversal Attacks.

UNIT - III: Injection Attacks

Injecting into Interpreted Contexts, SQL Injection, NoSQL Injection, XPath Injection, LDAP Injection, XML Injection, HTTP Injection.

UNIT - IV: Cross Site Scripting (XSS)

Types of XSS, XSS in Real World, Finding and Exploiting XSS Vulnerabilities, Preventing XSS Attacks.

UNIT - V: User Attacks

Inducing User Action, Capturing Cross-Domain Data, Client-Side Injection Attacks, Local Privacy Attacks, ActiveX Control attacks, Browser Attacks.

UNIT - VI: Source Code Analysis

Approaches to Code Review, Signatures of Common Vulnerabilities, Analysis of Java platform, Analysis of PHP, Analysis of Perl, Analysis of JavaScript, Analysis of SQL.

Text Book

1. DafyddStuttard, "The Web Application Hacker's Handbook", Wiley India Pvt. Ltd.

Reference Books

1. Web Security Testing Cookbook by Paco Hope, Ben Walther Publisher: O'Reilly Media
2. Web Security Sourcebook by Aviel D. Rubin, Daniel Geer, Marcus J. Ranum.

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Optional Elective - V

MANAGEMENT INFORMATION SYSTEMS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the information systems in Global Business today.
- To introduce the types of information systems and their functionalities in an enterprise.
- To familiarize with the applications of information systems in business areas
- To disseminate knowledge on Telecommunications and Networks in today's Business World

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the basic concepts, strategies and challenges of MIS.
- describe the nature of the information system in the business process.
- distinguish ethical and social issues in information systems considering the real world problems.
- choose the principal tools and technologies for accessing information from databases to improve business performance and decision making
- synthesize how do the Internet and Internet technology work and how do they support communication and e-business
- synthesize the working of Internet and Internet technology and how they support communications & e-business.

Course Content

UNIT - I: Managing the Digital Firm

Why Information Systems?, Dimensions of Information Systems, Contemporary Approaches to Information Systems-Technical Approach, Behavioral Approach, Socio technical Systems

UNIT - II: Information Systems, Organizations, Management and Strategy

Organizations and Information Systems -What Is an Organization, Features of Organizations, How Information Systems Impact Organizations and Business

Firms-Economic Impacts, Organizational and Behavioral Impacts, The Internet and Organizations.

UNIT - III: Ethical and Social Issues in the Digital Firm

Understanding Ethical and Social Issues Related to Systems, Five Moral Dimensions of the Information Age, Key Technology Trends That Raise Ethical Issues, Information Rights, Property Rights.

UNIT - IV: IT Infrastructure and Platforms

IT Infrastructure -Defining IT Infrastructure, Evolution of IT Infrastructure,Infrastructure Components- Computer Hardware Platforms, Operating System Platforms, Data Management and Storage .

UNIT - V: Managing DataResources

Organizing Data in a Traditional File Environment -File Organization Terms and Concepts, Problems with the Traditional File Environment, The Database Approach to Data Management: Database Management Systems.

UNIT - VI: Telecommunications, Networks and the Internet

Telecommunications and Networking in today's Business World,The Internet.

Text Books

1. Kenneth C Laudon& Jane P Laudon, Management Information Systems, 9th Edition, Pearson-2014.

Reference Books

1. V.M.Prasad, Management Information Systems, 9th Edition, Pearson Education–2005.
2. Robert G Murdick, Joel E Ross & James R Claggett, Information Systems for Modern Management, 3rd Edition, PHI - 2007.

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Optional Elective - V

ROBOTICS

III Year – II Semester

Lecture : -	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with anatomy, kinematics, sensors and dynamics of a programmable machine, robot.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- distinguish between fixed automation and programmable automation.
- identify various components of robot.
- select appropriate type of actuator for a joint.
- illustrate robot applications in manufacturing.
- analyze kinematics of a robot.
- develop equations of motion of a manipulator for a given application.
- create a trajectory plan for execution of a work cycle.

Course Content

UNIT - I:

Introduction: Automation and Robotics, Components of Robot – Mechanical manipulator-control system and end effectors-Types of end effectors — Requirements and challenges of end effectors classification of robots by coordinate system and control system. Control resolution, accuracy, repeatability and work volume of robot.

UNIT - II:

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric &

stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocitysensors.

UNIT - III:

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing operations - spot and continuous arc welding & spray painting - Assembly and Inspection.

Future applications of robots.

UNIT - IV:

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – Problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT - V:

Differential transformations and manipulator Jacobian – Problems,

Dynamics: significance of dynamic modelling of a robot, Lagrange – Euler formulation- LE formulation for inverted pendulum and two degree of freedom RR manipulator

Newton – Euler formulation –basic treatment.

UNIT - VI:

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint integrated motion

straight line motion – Robot programming, lead through programming and textual language programming.

Text Books

1. Groover M P ,"Industrial Robotics", TMH.
2. Mittal R K &Nagrath I J,"Robotics and Control", TMH.

Reference Books

1. Richard D. Klafter,"Robotic Engineering", Prentice Hall.
2. P. Coiffet and M. Chaironze,"An Introduction to Robot Technology", Kogam Page Ltd. 1983 London.
3. Asada,"Robot Analysis and Intelligence", Wiley Inter-Science.
4. John J Craig ,"Introduction to Robotics",Pearson Edu.
5. Mark W. Spong and M. Vidyasagar,"Robot Dynamics &Control",John Wiley & Sons (ASIA) Pvt Ltd.

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Professional Elective - III

MACHINE LEARNING AND PATTERN RECOGNITION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the field of Machine learning, in particular focusing on the core concepts of Supervised Learning.
- To familiarize with different types of learning algorithms.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe basic concepts of machine learning.
- apply Find-S and Candidate-elimination algorithms to solve problems of moderate complexity.
- calculate posterior probabilities using Bayes theorem.
- differentiate lazy and eager learning algorithms along with their strengths and weaknesses.
- recognize patterns using HMM and SVM.

Course Content

UNIT - I: Introduction

Well- Posed Learning Problems, Designing a Learning System, Perspectives and Issues in Machine Learning.

UNIT - II: Concept learning and the General to Specific Ordering

Introduction, A Concept Learning Task, Concept Learning as Search, Find-S: Finding a Maximally Specific Hypothesis, Version Spaces and the candidate-elimination Algorithm, Remarks on Version Spaces and Candidate-Elimination.

UNIT - III: Bayesian Learning

Introduction, Bayes theorem, Maximum Likelihood and Least-Squared Error Hypotheses, Minimum Description Length Principle, Bayes Optimal Classifier, Naive Bayes Classifier, Bayesian Belief Networks.

UNIT - IV: Instance-Based Learning

Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT - V: Pattern recognition using discrete hidden Markov models

Discrete-time Markov process, Extensions to hidden Markov models, three basic problems of HMMs, types of HMMs.

UNIT - VI: Support Vector Machines

Separating Data with the Maximum Margin, Finding the Maximum Margin, Efficient Optimization with SMO Algorithm, Speeding up Optimization with Full Platt SMO, Using Kernels for More Complex Data.

Text Books

1. Tom M. Mitchell, Machine Learning, MGH.
2. Pattern classifications, Richard O. Duda, Peter E. Hart, David G. Stroke. Wiley student edition, Second Edition.

Reference Books

1. Pattern Recognition, An Introduction, V Susheela Devi, M Narsimha Murthy, Universiy Press
2. Machine Learning in Action, Peter Harington, 2012, Cengage.

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Professional Elective - III

DISTRIBUTED OPERATING SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with distributed systems and architecture models.
- To impart the concepts of distributed processes, transactions and synchronization of processes.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe important characteristics, architectural features of distributed systems.
- identify various ways of Inter process Communications and synchronization using different algorithms.
- estimate the performance of various deadlock algorithms to achieve synchronization between the participating nodes of distributed system.
- analyze processes and processors and their scheduling policies to avoid deadlock and synchronization problems.
- classify different file system of distributed environment in storing and retrieving data efficiently using various file usage methods.
- distinguish multiprocessor, page based, shared-variable distributed shared memory.

Course Content

UNIT - I: Introduction to Distributed Systems

Goals, hardware concepts, software concepts, design issues, layered protocols, ,ATM Networks, client server model, remote procedure call, group communication.

UNIT - II: Synchronization in Distributed Systems

Clock Synchronization: Cristian's algorithm, the Berkeley algorithm, mutual exclusion: Centralized, distributed , token ring algorithms, election algorithms: the Bully and ring algorithms , atomic transactions.

UNIT - III: Deadlocks

Deadlocks in distributed systems, Distributed deadlock detection , centralized deadlock detection distributed dead lock prevention.

UNIT - IV: Processes

Processes and Processors in distributed systems- threads, system models, processor allocation, scheduling distributed system, Fault tolerance, real time distributed systems.

UNIT - V: Distributed File Systems

Distributed File system design: File service interface, Directory server interface, Semantics of file sharing, Distributed file systems implementation: File usage, System structure, Caching, replication, Trends in distributed file system.

UNIT - VI: Distributed shared memory

Introduction, on-chip memory, Bus based, ring based, switched multiprocessors, Consistency models: Strict, sequential and casual models. Page based shared memory, shared-variable distributed shared memory.

Text Books

1. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson, 17th Impression,2013.

Reference Books

1.Ajay D Kshemkalyani, MukeshSighal, "Distributed Computing, Principles, Algorithms and Systems", Cambridge University Press.

2.Abraham Silberchatz, Peter B. Galvin, Greg Gagne,"Operating System Principles" - 7th Edition, John Wiley.

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Professional Elective - III

HUMAN COMPUTER INTERACTION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce guidelines, principles, and theories influencing human computer interaction.
- To familiarize with range of approaches, techniques, tools and methods available to them when designing useful and usable technology.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- explain human and computer components functions regarding interaction with computer.
- illustrate the interaction between human and computer components.
- apply the screen design guidelines in creating User Interface.
- develop effective GUI using appropriate controls for windows based applications.
- choose appropriate widgets, components and tools for effective design of User Interface

Course Content

UNIT - I: Introduction

Importance of user interface – definition, history of screen design, importance of good design, benefits of good design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, characteristics.

UNIT - II: Design Process

Human interaction with computers, importance of human characteristics, human consideration, human interaction speeds, understanding business junctions.

UNIT - III: Screen Designing

Design goals, organizing screen elements, ordering of screen data and content, visually pleasing composition, focus and emphasis, presentation information, statistical graphics.

UNIT - IV: Windows

Navigation schemes, selection of devices based and screen based controls.

UNIT - V: Components

Text and messages, icons, colors, user problems, choosing colors.

UNIT - VI: Software Tools

Interaction Devices, speech recognition digitization and generation, image and video displays, drivers.

Text Books

1. Wilbert O. Galitz, "The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques", 2nd edition, John Wiley & Sons.
2. Ben Shneidermann, "Designing the User Interface", 3rd edition, Pearson Education Asia.

Reference Books

1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human–Computer Interaction", 3rd edition, Pearson.
2. Jenny Preece, Yvonne Rogers, Helen Sharp, "Interaction Design : Beyond Human-Computer Interaction", Wiley.
3. Soren Lauesen, "User Interface Design: A Software Engineering Perspective", Addison Wesley.

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Professional Elective - III

SOFTWARE TESTING METHODOLOGIES

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To disseminate knowledge on software testing techniques.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- formulate problem by following software testing life cycle.
- design test cases for testing a software project using black box testing techniques.
- apply path testing on a given program and uncover bugs present in the program.
- compare verification and validation in the context of software testing
- describe regression testing and software quality assurance.
- demonstrate the use software testing tools for testing projects.

Course Content

UNIT - I: Introduction and Methodology

Introduction, myths and facts, software testing terminology, software testing life cycle.

UNIT - II: Dynamic Testing I

Black Box Testing Techniques: Boundary value analysis, equivalence class testing, state table based testing and decision table based testing.

UNIT - III: Dynamic Testing II

White-Box Testing Techniques: Need, logic coverage criteria, basis path testing, loop testing, mutation testing, static testing: inspections-inspection team, inspection process, benefits of inspection process, structured walkthroughs, technical reviews.

UNIT - IV: Verification and Validation

Verification and validation activities, verification, verification of requirements, validation, validation activities.

UNIT - V: Regression Testing

Objectives of regression testing, when regression testing done? regression testing types, regression testing techniques. Software Quality Management: SQA models, debugging: process, techniques, correcting bugs.

UNIT - VI: Automation and Testing Tools

Need for automation, categorization of testing tools, selection of testing tools, cost incurred, guidelines for automated testing, overview of some commercial testing tools.

Text Books

1. Naresh Chauhan, "Software Testing, Principles and Practices", 1st edition, Oxford.
2. Aditya P Mathur, "Foundations of Software Testing", 2nd edition, Pearson.

Reference Books

1. Yogesh Singh, "Software Testing", Cambridge.
2. M G Limaye, "Software Testing, Principles, Techniques and Tools", TMH.
3. Willian E Perry, "Effective Methods for Software Testing", 3rd edition, Wiley.

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Professional Elective - IV

BUSINESS INTELLIGENCE

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the basic concepts of Business Intelligence, Technologies and management systems
- To familiarize with Data warehouses and model components. Business Intelligence Tools and methodology for developing business intelligence solutions.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- understand the concepts of Business Intelligence, technologies and organizations for developing solutions to organizations.
- acquire knowledge about different types of capabilities for the presentation of information.
- demonstrate the design of Data warehouses and enterprise architecture for data mining applications.
- apply data mining models to business analytics problems to identify the impact of BI on corporate business performance.
- employ data mining tools and techniques for customization and standardization in decision support systems.
- describe the characteristics and steps of good business intelligence solutions for decision making system

Course Content

UNIT - I: Business Intelligence and Its Impacts

Iintroduction, data, information, and knowledge, what is business intelligence?, driving factors , business intelligence and related technologies, contemporary organizations, obstacles to business intelligence.

UNIT - II: BI Capabilities

Introduction, four synergistic capabilities, organizational memory, information integration, insight creation: Factors for Insight Creation Capability and Technologies, presentation.

UNIT - III: Technologies Enabling Organizational Memory and Information Integration

Introduction enterprise resource planning systems, data warehouse, designing the enterprise architecture, knowledge repositories.

Introduction, integration of data sources in a business intelligence application, text mining, environmental scanning, web mining, application of web mining in customer relationship management.

UNIT - IV: Technologies Enabling Insights and Presentation

Technologies to create insights: using data mining to create new explicit knowledge, the business analytics process, the data mining models(what happened, what will happen, what happened), effective implementation of business analytics.

Presentation: online analytical processing, visual analytics, performance dashboards, balanced scorecards, it governance, impact of business intelligence on corporate performance.

UNIT - V: BI Tools

What are business intelligence tools? Tools Supporting Organizational Memory Capability, Tools Integration Capability, Insight Creation Capability, and Presentation Capability, customization versus standardization of BI tools, leading business intelligence vendors.

UNIT - VI: Development of Business Intelligence

Introduction, BI solutions , characteristics of good business intelligence solution, sourcing of solutions, methodology and steps in the for developing business intelligence solutions.

Text Book

1. Rajiv Sabherwal, Irma Becerra-Fernandez, "Business Intelligence Practices, Technologies, and Management", John Wiley & Sons, Inc.

Reference Books

1. Vicki L. Sauter, "Decision Support Systems for Business Intelligence", second edition, a john Wiley & sons, inc. Publication.
2. Efraim Turban, Ramesh Sharda, Dursun Delen "Decision Support Systems and Intelligent Systems", , 9th Edition, Pearson 2011.
3. Galit Shmueli, Nitin R. Patel and Peter C. Bruce "Data Mining for Business: Intelligence Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", , Wiley, 2007.

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Professional Elective - IV

MOBILE COMPUTING
(Common to CSE & IT)
IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the concepts of mobile computing paradigm, GSM, and various layers of mobile networks.
- To introduce the database issues, data delivery models, ad hoc networks platforms and protocols used in mobile environment.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain mobile computing paradigm, GSM, and layers of mobile networks.
- outline the mobile IP and Dynamic Host Configuration Protocol in network layer.
- describe the different TCP's and transmission mechanisms in transport layer.
- llustrate Data Dissemination and Synchronization models for applications.
- synthesize MANET applications and routing algorithms with security mechanisms.
- summarize the layers and functionalities in wireless application protocol and Bluetooth.

Course Content

UNIT - I: Introduction

Introduction to MC, novel applications, limitations, and architecture.

GSM-Mobile services, system architecture, radio interface, protocols, localization and calling, handover, security, and new data services.

[**UNIT - II: Mobile Network Layer**

Mobile IP (goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).

UNIT - III: Mobile Transport Layer

Traditional TCP, indirect TCP, snooping TCP, mobile TCP, fast retransmit/fast recovery, transmission /time-out freezing, selective retransmission, transaction oriented TCP.

UNIT - IV: Database Issues and Dissemination

Database Issues-Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues.

Data Dissemination-Communications asymmetry, Classification of new data delivery mechanisms.

UNIT - V: Mobile Adhoc Networks

Overview, properties of a MANET, spectrum of MANET applications, routing and algorithms, security in MANETs.

UNIT - VI: Protocols and Tools

Wireless Application Protocol-Introduction, protocol architecture, and treatment of protocols of all layers, Bluetooth-user scenarios, physical layer, MAC layer, networking, security, link management.

Text Books

1. Jochen Schiller,"Mobile Communications",2nd Edition, AddisonWesley.
2. Raj Kamal, "Mobile Computing", 2nd Edition, Oxford University Press.

Reference Books

1. Frank Adelstein, Sandeep KS Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing", McGraw-Hill.
2. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley.

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Professional Elective - IV

MULTIMEDIA TOOLS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of multimedia, animation and digital video.
- To familiarize with multimedia authoring tools.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline Multimedia and list its applications.
- categorize the usage of color palettes in multimedia.
- generalize the principles of Animation and expand various video formats.
- demonstrate the four primary stages in a multimedia projects.
- collect various Multimedia Authoring tools.
- discuss various multimedia tools for Internet and WWW.

Course Content

UNIT - I: Introduction

Definitions- Multimedia, Interactive multimedia, Hypermedia, Multimedia developers, Where to use Multimedia, Delivering Multimedia.

UNIT - II: Images

Color, Computerized Color- Additive & Subtractive Colors, Color Palettes, Dithering, Bitmap Images – Data Matrix for 1-bit, 4-bit, 8-bit, 24-bit.

UNIT - III: Animation and Video

Animation: Power of motion, Principles of Animation, Animation by Computer – 2-D, 3-D Video: Digital Video – HDTV, Codecs – MPEG, Video Format Converters.

UNIT - IV: Making Multimedia

Stages of Multimedia Project, Hardware - Memory and storage Devices, Input and Output Devices, Software – Text Editing, OCR Software, Painting and Drawing Tools, 3-D Modeling and Animation Tools, Authoring Systems.

UNIT - V: The Internet and Multimedia

World Wide Web and HTML, Multimedia on Web – Web Servers, Web Browsers, Web Page Makers and Site Builders, Plugins – Text, Images, Sound, Animation, Video, Presentation, 3-D Worlds.

UNIT - VI: Designing for the World Wide Web

Text for Web, Images for Web – GIF, PNG, JPEG, GIF or JPEG? Animation for Web – GIF98a, Plugins and Players.

Text Book

1. Tay Vaughan, "Multimedia- Making It Work", 8th Edition, 2011, TMH.

Reference Book

1. Joseph W Lowery, "Adobe CS5 Bible Dream weaver Bible", 2010, Wiley publication.

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Professional Elective - IV

CRYPTOGRAPHY AND NETWORK SECURITY
(Common to CSE & IT)
IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize different types of security attacks and services.
- To expose different cryptographic techniques and algorithms.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- describe security attacks and services over networks.
- differentiate symmetric and asymmetric encryption techniques.
- apply integrity checking and authentication techniques.
- compare E-mail security and IP level security.
- use firewalls and intrusion detection techniques for system security.
- outline web security threats and counter measures.

Course Content

UNIT - I: Security Fundamentals

Security Attacks, Security Services, Security Mechanisms, A model for Network security. Non-cryptographic protocol vulnerabilities - Session hijacking and Spoofing. software vulnerabilities - Phishing, Buffer Overflow, Format string Attacks, SQL Injection.

UNIT - II: Secret Key Cryptography

Symmetric cipher model, Block and Stream ciphers, Data Encryption Standard (DES), Strength of DES, Block cipher design principles and modes of operation, Triple DES, AES Structure.

UNIT - III: Public-key Cryptography

Public-key Cryptography, Principles of public-key crypto systems, RSA algorithm, Diffie-Hellman key exchange, Introduction to elliptic curve cryptography.

UNIT - IV: Hash Functions and Digital Signatures

Cryptographic hash functions, Applications of cryptographic hash functions, secure hash algorithm, authentication algorithms- HMAC, Digital signatures, Digital Signature algorithm.

UNIT - V: E-mail Security and IP Security

E-mail Security: PGP, S/MIME.

IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload.

UNIT – VI: Web Security and System Security

Web Security-Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS).

System Security -Firewall Design principles, Intrusion Detection Systems.

Text Books

1. William Stallings, "Cryptography and Network Security Principles and Practice", 5th edition, Pearson Education.
2. Bernard Menezes, "Network security and cryptography", Cengage Learning.

Reference Books

1. William Stallings, "Network Security Essentials", 4th edition, Pearson education.
2. Eric Maiwald, "Fundamentals of Network Security", 1st edition, Dream Tech press.
3. Buchmann, "Introduction to Cryptography", Springer.

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Optional Elective - VII

SOCIAL NETWORKS

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with technological concepts of social networks.
- To provide a comprehensive overview of social network systems.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline social network concepts
- categorize network segments and their characteristics.
- analyze psychological foundations of social networks.
- evaluate network structure of organizations.
- examine network influence and diffusion of ideas.
- evaluate network as social capital.

Course Content

UNIT - I: Basic Social Network Concepts

Network, sociological questions about relationships, dyads and mutuality and balance and triads-distributions-dyads and triads, density, structural holes, weak ties, popularity or centrality, distance, size of interpersonal environment and the small world-multiplexity-role multiplexity and content multiplexity-roles and positions-named positions and relationships and informal relations and hierarchies-embedded of the informal within instituted or named networks.

UNIT - II: Network Segmentation

Named and unnamed network segments and primary groups, cliques and clusters-segmenting networks from the point of view of observer-segmenting networks on the basis of cohesion, resistance to disruption, structural similarity and structural equivalence and core/periphery structures.

UNIT - III: Psychological Foundations of Social Networks

Community and support, safety and affiliation-effectiveness and structural holes-safety and social networks, effectiveness and social networks, both safety and effectiveness-driving for status or rank, cultural differences in safety, effectance and rank, cognitive limits on individual networks.

UNIT - IV: Organizations and Networks Information

The contradictions of authority, emergent networks in organization, factory floor and information driven organizations, bridging the gaps: Tradeoffs between network size, diversity and social cohesion.

UNIT – V: Networks Influence and diffusion

The basic model, influence and decision making, epidemiology and network diffusion.

UNIT - VI: Network as Social Capital

Individual level social capital, social capital as an attribute of social systems.

Text Books

1. Charles Kadushin, "Understanding Social Networks: Theories, Concepts, and Findings" Oxford University Press.

Reference Books

1. Peter Mika, "Social Networks and the Semantic Web", Springer Science & Business Media.
2. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications", Cambridge University Press.

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Optional Elective - VII

ASSISTIVE TECHNOLOGIES

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce different Assistive Technology devices.
- To familiarize with the concepts of Enhance speech communication and Independent living.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the legislative policies connected with assistive Technologies.
- Know the Universal design principles in the context of general education environments and curriculum materials.
- explore the process for finding the right technology and the right applications, and determine how to pay for it.

Course Content

UNIT - I: Introduction to Assistive Technology (AT) Devices and Services

Assistive Technology Defined. Historical overview of Assistive Technology. Multidisciplinary nature of service Provision.

UNIT - II: Adaptations Framework for Considering Assistive Technology

Introduction to the Adaptations Framework, Setting-Specific Demands, Person-Specific Characteristics, Adaptations, Evaluation of Effectiveness of Adaptations.

UNIT - III: Assistive Technology Assessments

Overview of Assessment Issues, Overview of General Assessments, Assistive Technology Assessments, Assessment Components.

UNIT - IV: Enhance Speech Communication

Nature of Spoken Language, Introduction to Augmentative and Alternative Communication Systems, Selection Techniques for Aided Communication Systems, Overview of Non-electronic Systems and Electronic Devices.

UNIT - V: Mobility and Access to Information

Introduction to Mobility Adaptations, Basic Design Considerations, Seating and Positioning Issues. Introduction to Information Access, Computer Access, Telecommunication, Listening and Print Access.

UNIT - VI: Enhance Independent Living

Introduction to Independent Living, Devices for Daily Life, Switches and Scanning. Environmental Control Units, Access to Management Devices.

Text Books

1. Diane P edrotty Bryant, Brian R. Bryant, Allyn and Bacon "Assistive Technology for People with Disabilities", 2nd edition ***Psycho-Educational Services.***
2. Amy G.Dell, Deborah A.Newton, Jerry G.Petroff, "Assistive Technology in the class room Enhancing the school experiences of students with disabilities", Pearson Publications.

Reference Books

1. Marion A.Hersh, Michael A.Johnson , " Assistive Technology for the Hearing impaired, Deaf and Deafblind", Springer Publications.
2. Meeko Mitsuko K.Oishi, Ian M.Mitchell, H.F. Machiel vanderloss, "Design and use of Assistive Technology, Springer Publications.
3. Eckehard Fuzzy Moritz, "Assistive Technologies for the Interaction of the Elderly", Springer Publications.

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Optional Elective - VII

RENEWABLE ENERGY SOURCES

IV Year – I Semester

Lecture : -		Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To study various types of non-conventional sources of energy and techniques used in exploiting solar, wind, tidal and geothermal sources of energy and bio-fuels.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- analyze the significance of renewable energy.
- describe the principles of solar radiation and design the solar collectors.
- know the functioning of basic components of wind energy and understand the utilization of biomass in power generation.
- discuss the working principles of geothermal, ocean, tidal and wave energy techniques.
- know the functioning of direct energy conversion techniques.

Course Content

UNIT - I: Introduction

Energy Sources and their availability, Role and potential of renewable source.

Principles of Solar Radiation: Solar constant, Solar Radiation outside the Earth's atmosphere, Solar Radiation at the Earth's surface, instruments for measuring solar radiation, solar radiation geometry, solar radiation on titled surfaces with numerical problems.

UNIT - II: Solar Energy Storage and Applications

Different methods, sensible, latent heat and stratified storage, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation, drying, photovoltaic energy conversion, solar central power tower concept and solar chimney. solar collectors- flat plate, concentric collectors.

UNIT - III: Wind Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

Bio-Mass: Biomass Energy Sources, methods for obtaining energy from biomass, Biomass gasification.

UNIT - IV:

Geothermal Energy: Resources, types of wells, methods of harnessing the energy.

Ocean Energy: OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles.

Tidal and wave energy: Potential and conversion techniques, Mini-hydel power plants

UNIT - V:

Direct Energy Conversion(DEC): Need for DEC, limitations, principles of DEC. Thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators.

UNIT - VI: MHD Power Generation

Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion.

Fuel cells: Principles, Faraday's laws, thermodynamic aspects, selection of fuels and operating conditions, applications.

Text Books

1. Tiwari and Ghosal, "Renewable energy resources", Narosa.
2. B.H.Khan "Non – conventional Energy Resources" Tata McGraw Hill education Pvt Ltd.

Reference Books

1. G.D. Rai, "Non-Conventional Energy Sources", Dhanpat Rai and Sons
2. Twidell & Weir, "Renewable Energy Sources " Sukhatme, "Solar Energy", Tata McGraw-Hill Education.

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Professional Elective - V

STEGANOGRAPHY AND BIOMETRICS

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the concepts of stenographical communication
- To introduce various verification , identification technologies and matching measures of Biometrics
- To impart various scan technologies.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the basic terminology of steganography.
- interpret different scenarios related to steganalysis.
- distinguish between Biometric verification and identification.
- apply Finger Scan and Facial Scan Technologies to provide person identification in logical access environment.
- compare and contrast physiological biometrics with behavioral biometrics in terms of their accuracy.

Course Content

UNIT - I: Steganography

Steganographic communication, notation and terminology, Information-Theoretic foundations of Steganography, practical steganographic methods

UNIT - II: Steganalysis

Steganalysis scenarios, some significant steganalysis Algorithms, LSB embedding and the histogram attack, sample pairs analysis.

UNIT - III: Biometrics

Benefits of biometric security–Verification and identification–Basic working of biometric matching – Accuracy – False match rate – False non-match rate – Failure to enroll rate–Derived metrics–Layered biometric solutions.

UNIT - IV: Finger scan

Features – Components – Operation (Steps) – Competing finger Scan technologies, Strength and weakness

UNIT - V: Facial Scan

Features – Components – Operation (Steps) – Competing facial Scan technologies, Strength and weakness

UNIT - VI: Other physiological biometrics

Hand scan – Retina scan – AFIS (Automatic Finger Print Identification Systems) Behavioral Biometrics–Signature scan-keystroke scan.

Text Books

1 Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, and Ton Kalker, "Digital Watermarking and Steganography", 2/e, Morgan Kaufmann Publishers, 2008.

2 Samir Nanavati, Michael Thieme, Raj Nanavati, "Biometrics – Identity Verification in a Networked World", WILEY-DreamTech

Reference Books

1. John Chirillo and Scott Blaul, "Implementing Biometric Security", Wiley Eastern Publications, 2005.

2 JohnD.Woodward, "Biometrics-The Ultimate Reference" Jr.Wiley Dreamtech.

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Professional Elective - V

PARALLEL COMPUTING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of Parallel Computing.
- To disseminate knowledge on CUDA.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the fundamentals of Parallel computing.
- demonstrate Flynn's taxonomy.
- classify Different Structures of Parallel Computers.
- identify the methodologies for the development of parallel processing applications using CUDA.
- determine the important features of Graphical Processing Unit in application development.
- design and develop programs using CUDA Development Tool kit.

Course Content

UNIT - I:

Introduction: Why do we Need High Speed Computing, How do we Increase the Speed of Computers, History of Parallel Computers.

Solving problems in parallel: Utilizing Temporal Parallelism, Utilizing Data Parallelism, Comparison of Temporal and Data Parallel Processing

UNIT - II:

Parallel Architectures: Interconnection networks, processor arrays, multiprocessors, multicomputer, Flynn's taxonomy.

UNIT - III:

Structure of parallel computers: A Generalized Structure of a Parallel Computer, Classification of Parallel Computers, Vector Computers, A Typical Vector Super

Computer, Shared Memory Parallel Computers, Message Passing Parallel Computers.

UNIT - IV:

Operating systems for parallel computers: Resource Management, Process Management, Process Synchronization, Inter-process Communication, Memory Management, Input/output (Disk Arrays).

UNIT - V:

Computer Unified Device Architecture (CUDA): The age of parallel processing, The rise of GPU computing, CUDA, Applications of CUDA.

UNIT - VI:

Development Environment: CUDA Enabled Graphics Processors, NVIDIA Device driver, CUDA Development Tool kit, Standard C compiler.

Text Books

1. Parallel Computers Architecture and Programming, V. Rajaraman, C. Siva RamMurthy,PHI.
2. CUDA by Example, Jason Sanders, Edward Kandrot, Addison_Wesley.

Reference Books

1. Introduction to Parallel Computing, AnanthGrama, Anshul Gupta, George Karypis,Vipin Kumar,Pearson Education.
2. M.J. Quinn, Parallel Computing Theory and Practice, McGraw Hill, 2002.
3. M.J. Quinn, Parallel Programming in C with MPI and OpenMP, McGrawHill, 2008.

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VIRTUAL AND AUGMENTED REALITY

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce key elements of virtual Reality with the components in VR systems..
- To disseminate knowledge on input and output devices required for interacting in virtual world and augmented reality.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- identify basic elements of virtual Reality
- describe various input and output devices required for VR experience
- classify human factors that affect VR experience
- distinguish augmented reality from virtual reality
- determine the object position and orientation in virtual space.

Course Content

UNIT - I: Introduction

The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.

UNIT - II: Input Devices

Trackers, Navigation, and Gesture Interfaces: Three-dimensional position trackers, Navigation and manipulation, interfaces and gesture interfaces.

UNIT - III: Output Devices

Graphics displays, sound displays and haptic feedback.

UNIT - IV: Human Factors

Methodology and terminology, user performance studies, VR health and safety issues.

Applications: Medical applications, military applications, robotics applications.

UNIT - V: Augmented Reality

Introduction, Head-Up Displays, Helmet-Mounted Sights and Displays, Smart Glasses and Augmenting Displays

UNIT - VI: Understanding Virtual Space

Visual and Object Space, Defining Position and Orientation in Three Dimensions

Text Books

1. John Vince, "Virtual Reality Systems", Pearson Education.
2. Steve Aukstakalnis,"Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", Addison-Wesley.

Reference Books

1. Brett S. Martin, "Virtual Reality", Norwood House Press, 2017.
2. Alan B. Craig, "Understanding Augmented Reality: Concepts and Applications", Newnes.

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Professional Elective - V

E-COMMERCE

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the basic concepts of E-Commerce, Mercantile Process model, e-payment systems.
- To disseminate knowledge on electronic data interchange (EDI),workflow automation, SCM and advertising on internet.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the fundamentals in E-Commerce with respect to consumer and organization oriented applications
- compare Mercantile process models in context to consumer and merchant perspectives
- illustrate smart cards, credit/debit cards, Digital token based systems
- analyze the EDI problems and performance of VAN in inter-organizational commerce
- classify the procedures of work flow automation and SCM to improve intra-organizational commerce
- distinguish digital documents from document library for development of E-commerce through online marketing process

Course Content

UNIT - I: Welcome to Electronic Commerce

Electronic commerce framework, Electronic commerce and media convergence, the anatomy of e-commerce applications, Electronic Commerce Consumer applications, Electronic Commerce organization applications

UNIT - II: Consumer Oriented Electronic Commerce

Introduction to Consumer Oriented Electronic commerce, Mercantile Process Models from the Consumer's Perspective, Mercantile Process Models from the Merchant's Perspective

UNIT - III: Electronic Payment Systems

Digital Token-Based Electronic payment systems, Smart Cards and Electronic Payment Systems, Credit Cards based electronic payment systems, Risks in Electronic Payment systems

UNIT - IV: Inter-organizational Commerce and EDI

Electronic Data Interchange (EDI), EDI Software Implementation, Value added networks (VANs)

UNIT - V: Intra-organizational Commerce

Work Flow Automation and Coordination, Customization and internal Commerce, Supply Chain Management (SCM)

UNIT - VI: Corporate Digital Library and Advertising, Marketing on Internet

Making a business case for a document library, Types of Digital documents, Corporate Data warehouse, the new age of Information-Based marketing, advertising on the Internet, Charting the on-line Marketing Process, Market research

Text Book

1. Kalakota, Whinston,"**Frontiers of electronic commerce**", Pearson.

Reference Books

1. HendryChan,RaymondLee,TharamDillon,ElizabethChang,"E-Commercefundamentalsandapplications", Wiley.
2. S.Jaiswal, "E-Commerce", Galgotia.
3. Kenneth C.Taudon, Carol Guyerico, Traver,"E-Commerce – Business, Technology,Society", Addison-Wesley Pub.

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INTERNET OF THINGS

IV Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To introduce the fundamentals of Internet of Things.
- To familiarize with the building of small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline the basic concepts of Internet of Things.
- analyze the requirements and specifications to design home automation applications.
- develop smart city applications using ArduinoIoT kit.
- design agricultural applications using Raspberry pi IoT kit.
- use the tools such as AutoBahn, Xively Cloud communication API's to exchange data between cloud and IoT kit.
- analyze Home Automation, Agriculture, Smart City applications.

Course Content

UNIT - I: Fundamentals of IoT

Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies– IoT Levels and Deployment Templates – M2M, IoTvs M2M.

UNIT - II: IoT Design Methodology

IoT Design Methodology: Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional View Specification, Operational View specification, Device & Component Integration and Application Development.

UNIT - III: Prototyping Embedded Device with ARDUINO

Sensors, Actuators, Embedded Computing Basics- Micro Controllers, System on Chips, Choosing your Platform, Arduino – Developing on the Arduino.

UNIT - IV: Prototyping Embedded Device with Raspberry PI Raspberry PI – Introduction, cases and Extension Boards, Developing on the Raspberry PI.

UNIT - V: IoT Physical Servers & Cloud Offerings

Introduction to Cloud Storage Models & Communication APIs – WAMP – AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework - Django.

UNIT - VI: Domain Specific Applications of IoT

Home Automation, Agriculture Applications, Smart City applications.

Text Books

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", UniversitiesPress, 2015.
2. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", Wiley Publications – 2014.

Reference Books

1. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.
2. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014.
3. WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".

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CLOUD COMPUTING
(Common to CSE & IT)
IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide the architectural concepts of Cloud computing.
- To familiarize with cloud service models and cloud based applications.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- differentiate the stages in historical evolution of cloud computing.
- use suitable cloud services to define cloud for the enterprise.
- demonstrate hardware level and OS level virtualization to implement virtual machines.
- design machine images, web applications and databases for virtual machines.
- apply data, network and host security for the cloud.

Course Content

UNIT - I: Cloud Computing

Introduction, cloud computing: What it is and what it isn't, from collaboration to the cloud : A short history of cloud computing, the network is the computer: How cloud computing works, understanding cloud architecture , storage, services; The pros and cons of cloud computing. Who benefits from cloud computing? who shouldn't be using cloud computing.

UNIT - II: Defining Clouds for the Enterprise

Storage-as-a-Service, Database-as-a-Service, Information-as-a-Service, Process-as-a-Service, Application-as-a-Service, Platform-as-a-Service, Security-as-a-service, Infrastructure-as-a-Service.

UNIT - III: Virtual Machines and Virtualization

Implementation levels of virtualization: levels of virtualization implementation, VMM design requirements and providers, virtualization support at the OS level, virtualization structures/tools and mechanisms: Hypervisor and Xen architecture, binary transition with full virtualization, para-virtualization with compiler support.

UNIT - IV: Hardware Virtualization

Virtualization of CPU, memory and I/O devices: Hardware support for virtualization, CPU virtualization, memory virtualization, I/O virtualization.

UNIT - V: Ready for the cloud

Web application design, machine image design, privacy design, database management: clustering or replication? primary key management, database backups.

UNIT - VI: Security

Data Security: data control, encrypt everything, regulatory and standards compliance; Network Security: firewall rules, network intrusion detection; Host Security: system hardening, antivirus protection, host intrusion detection, data segmentation, credential management; Compromise response.

Text Books

1. Kai Hwang, Jack Dongarra and Geoffrey C.Fox, "Distributed and Cloud Computing:From Parallel Processing to the Internet of Things", 1st edition, Morgan Kaufman Publications.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", 1st edition, O'Reilly.

Reference Books

1. Michael Miller, "Cloud Computing- Web Based Applications That Change the Way You Work and Collaborate Online", 1st edition, Que publications.
2. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide" Addison Wesley.

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Professional Elective - VI

BLOCKCHAIN TECHNOLOGIES
(Common to CSE & IT)
IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the fundamental concepts of Block Chain.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- outline fundamentals of Block chain.
- analyze the working of Block Chain.
- describe propelling business with block chains.
- illustrate Hyperledger and Linux Foundation Project, use cases.
- summarize challenges of Block chain

UNIT - I: Grasping Blockchain Fundamentals

Tracing Blockchain's Origin, The shortcomings of current transaction systems, the emergence of bitcoin, The birth of blockchain, Revolutionizing the Traditional Business Network, Exploring a blockchain application, Recognizing the key business benefits, Building trust with Blockchain.

UNIT - II: Taking a Look at How Blockchain Works

Why It's Called "Blockchain", What Makes a Blockchain Suitable for Business?, Shared ledger, Permissions, Consensus, Smart contracts ,Identifying Participants and Their Roles.

UNIT - III: Propelling Business with Blockchains

Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility.

UNIT - IV: Blockchain in Action: Use Cases

Financial Services, Commercial financing, Trade finance, Cross-border transactions, Insurance, Government, Supply Chain Management, Healthcare, Electronic medical records. Healthcare payments pre-authorization, The Internet of Things (IoT).

UNIT - V: Hyperledger, a Linux Foundation Project

Hyperledger Vision, Hyperledger Fabric, How Can IBM Help Developers Innovate With Blockchain: Offering an easily accessible cloud and development platform, individualized attention and industry expertise.

UNIT - VI: challenges of Block chain

Technical challenges, Business model challenges, scandals and public perception, government regulation, privacy challenges for personal records, decentralization trends likely to persist.

Text Book

1. Blockchain For Dummies®, IBM Limited Edition, Manav Gupta, John Wiley & Sons, Inc.111 River St,Hoboken, NJ 07030-5774

Reference Book

1. Swan, Melanie, "Blockchain: Blueprint for a new economy", O'Reilly Media, Inc.", 2015.

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Professional Elective - VI

DESIGN PATTERNS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize withStructural and behavioral Design Patterns.

Learning Outcomes

Upon successful completion of the course, the students will be able to

- demonstrate how Design Patterns Solve Design Problems.
- design a Document Editor using Design Patterns.
- use Creational Patterns for object creation mechanism.
- demonstrate how Structural Design Patterns use to ease the design by identifying a simple way to realize relationships between entities.
- implement behavioral design patterns in carrying out communication between objects

Course Content

UNIT - I:

Introduction: Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT - II:

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary.

UNIT - III:

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

UNIT - IV:

Structural Pattern Part-I: Adapter, Bridge, Composite, decorator, façade, Flyweight, Proxy.

UNIT - V:

Behavioral Patterns Part-I: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method ,Visitor, Discussion of Behavioral Patterns.

UNIT - VI:

What to Expect from Design Patterns, A Brief History, The Pattern Community An Invitation, A Parting Thought.

Text Book

1. Erich Gamma, "Design Patterns", Pearson Education

Reference Books

1. Pattern's in JAVA Vol-I By Mark Grand ,Wiley DreamTech.
2. JAVA Enterprise Design Patterns Vol-III By Mark Grand ,Wiley DreamTech.

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Professional Elective - I

COMPUTATIONAL METHODS IN STRUCTURAL ENGINEERING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- become familiar with numerical methods.
- know how to solve ODE numerically.
- understand the procedures to find correlation and regression.
- know how to solve linear and fractional programming problems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve eigen value problems and system of D.E.s
- apply different methods to solve the problems related to finite differences.
- solve boundary value problems numerically

4. find correlation, regression for a given data and able to estimate different parameters.

- find the optimal solutions to linear and fractional programming problems.

Course Content

UNIT – I: Solutions of Linear Equations

Iterative methods : Gauss – Siedel iteration method, Successive over –relaxation method.

Eigen values and Eigen vectors: Jacobi method for symmetric matrices, Rutishauser method of arbitrary matrices – Power method.

UNIT – II: Finite Difference and their Applications

Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation - Use of unevenly spaced pivotal points – Application to Simply Supported Beams.

UNIT – III: Numerical Solutions of Ordinary Differential Equations

Boundary Value Problems: Shooting Method – solution through a set of equations - derivative boundary conditions - Rayleigh Ritz Method.

UNIT – IV: Random Variables And Estimation Theory

Probability - Probability distributions - moments, M.G.F-Two dimensional random variables correlation, regression multiple and partial correlation and regression - Estimation theory basic concepts (Review) - Estimation of parameters - Maximum likelihood estimates - method of moments.

UNIT – V: Optimization Techniques

Linear Programming: Mathematical formulation-graphical solution of two variable – simplex method-artificial variable technique- Big M method- linear fractional programming problem.

Text Books

1. Numerical methods for Engineers by Steven C.Chapra and Raymond P.Canale – McGraw Hill Book Company.
2. Introductory Methods of Numerical Analysis by S. S. Sastry (PHI)
3. An Outline of Statistical Theory, Vol. I, II by A. M. Goon, M. K. Gupta, B. Dasgupta (The World Press Pvt. Ltd.)
4. Linear and Nonlinear Optimization: Second Edition, Igor Griva, Stephen G. Nash, ArielaSofer

Reference Books

1. Advanced Engineering Mathematics by Stanley Grossman & William R. Derrick (Harper & Row Publishers).
2. Applied numerical analysis by Curtis. F.Gerald- AddesonWesely Publishing Company.

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Professional Elective - I

ADVANCED R.C. DESIGN

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- Impart the knowledge on designing various type of structures like bunkers, silos, grid floors, flat slabs, shear walls and multi-stored building frames.

Course Outcomes

Upon successful completion of the course, the students will be able to

- design the bunkers and silos
- analyze grid floors using approximate methods
- design flat slab.
- gets reasonable expertise to implement ductile detailing and also design solid shear walls
- gain the knowledge on concept of designing Multi-storeyed building frames

Course Content

UNIT – I: Bunkers and Silos

Introduction - Design principles and theories - IS Code provision - design of rectangular bunkers - design of cylindrical soils.

UNIT – II: Approximate analysis of Grid Floors

Introduction, analysis of rectangular grid floors by Timoshenko's plate theory and stiffness matrix method, comparison of methods of analysis, reinforcement detailing in grid floor.

UNIT – III: Flat Slabs

Introduction, components, IS code provisions, Design Methods, design for flexure and shear

UNIT – IV: Ductile Detailing

Ductile detailing of RCC beams and columns using IS: 13920-1993 code **Design of Shear Walls:** Design and Detailing of Shear Walls considering shear wall-frame interaction in a tall RC structure subjected to seismic loading.

UNIT – V: Multi-Storey Building Frames

Introduction-analysis of Multi-storey Frames-Method of substitute Frames-Design Example-Bending Moments in Columns-Analysis of Multi-storey frames subjected to horizontal forces-Design Example.

Text Books

1. P.C. Varghese, "Advanced Reinforced Concrete Design", Prentice Hallpublication(Unit II,III&IV)
2. N.Krishnam Raju ,"Advanced Reinforced concrete Design", CBSpublication.(Unit I&V)

Reference Books

1. Park & Paulay, "Reinforced Concrete", John Wiley & sons Publications.
2. Pillai and Menon, "Reinforced concrete Design ".
3. H.J. Shah, "*Reinforced Concrete"*, Charotar Publishers, 2014.

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Professional Elective - I

EXPERIMENTAL STRESS ANALYSIS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- learn about the various approaches of stress application on any members.
- understand the knowledge of analysis of stress on concrete.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the importance of stress and various methods of stresses applied.
- apply the knowledge of strain measurement and using them in design criteria.
- enumerate strain rosettes and applications to concrete.
- understand the importance of 2 D photoelasticity.

Course Content

UNIT – I: Principles of Experimental Approach

Merits of Experimental Analysis Introduction, uses of experimental stress analysis advantages of experimental stress analysis, Different methods – Simplification of problems.

UNIT – II: Strain Measurement using Strain Gauges

Definition of strain and its relation of experimental Determinations Properties of Strain Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical strain gauges - Inductance strain gauges – LVDT – Resistance strain gauges – various types – Gauge factor – Materials of adhesion base.

UNIT – III: Strain Rossettes and Non – Destructive Testing of Concrete

Introduction – the three elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity method – Application to Concrete. Hammer Test – Application to Concrete.

UNIT – IV: Theory of Photoelasticity

Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polar scope for various arrangements – Fringe Sharpening. Brewster's Stress Optic law.

UNIT – V: Two-Dimensional Photoelasticity

Introduction – Isochramic Fringe patterns- Isoclinic Fringe patterns passage of light through plane Polariscope and Circular polariscope Isoclinic Fringe patterns – Compensation techniques – Calibration methods – Separation methods – Scaling Model to prototype Stresses – Materials for photo – Elasticity Properties of Photo elastic Materials.

Text Books

1. Experimental stress analysis by Dr.SadhuSingh.khanna Publishers 5th edition.
2. Experimental Stress analysis by U.C.Jindal, Pearson Pubilications, latest edition.
3. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers 4th edition.

Reference Books

1. Theory of Elasticity by S P Timoshenko and J N Goodier, MC.Graw Hill Company Publishers 3rd edition.
2. Experimental Stress Analysis by J W Dally and W F Riely, MC.Graw Hill Company Publishers 3rd edition.
3. Experimental Stress Analysis and Motion Measurements by R C Dove and P H Adams, Publisher: Merrill; First *Edition edition*(1964)
4. Some Basic Problems of the Mathematical Theory of Elasticity by N I Mushelishvili, Third, revised and augmented edition, Moscow, 1949.

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Professional Elective - II

THEORY OF PLATES AND SHELLS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- familiarize the behavior of the plates and shells with different geometry under various types of loads.

Course Outcomes

Upon successful completion of the course, the students will be able to

- evaluate the deflection of plates for different loadings.
- understand the concept of folded plates.
- determine various forces in shells.
- explain the concept of curvature in shells.
- gain knowledge on beams, theory of cylindrical shells.

Course Content

UNIT – I: Rectangular Plates

Pure bending of Plates – Relations between bending moments and curvature – Derivation of governing differential equation for plate – Slope and curvature of slightly bent plates. Rectangular Plates: Plates under uniformly distributed load with different boundary conditions.

UNIT – II: Circular Plates

Circular plates: Symmetrically loaded, Circular plates under various loading Conditions, Circular plate with a circular hole at center.

UNIT – III: Folded Plates

Structural behavior of folded plates; Equation of three shears; Application of Simpson's and Whitney's methods.

UNIT – IV: Introduction To Shells

Introduction to shells -Classification of shells- Equations of Equilibrium of shells: Derivation of stress resultants, principles of membrane theory and bending theory.

UNIT – V: Cylindrical Shells

Cylindrical Shells: Derivation of the governing DKJ equation for bending theory, details of Schosrer's theory. Beam method of analysis..

Text Books

1. Timoshenko and Krieger - Theory of plates and shells, McGraw-Hill book company, INC, New York.
2. H.Kraus - Thin Elastic Shells, John Wiley and sons (1967), New York
3. P.C. Varghese,” Design of Reinforced Concrete Shells and Folded plates”, PHI Learning Private Limited, New Delhi (2010).
4. J.N.Reddy (1999)-Theory and Analysis of Elastic Plates, Taybr and Francis, Philadelphia.

Reference Books

1. S.S.Bhavikatti ,”Theory of plates and shells”, New Age International, New Delhi
2. Chandrasekhar k (2001) – Theory of Plates, University Press, Hyderaba
3. J. Ramachandran,” Thin Shells Theory and Problems”, Universities Press. “Stresses in shells”, Flugge, 2nd Edition, Springer.
4. Bairagi. K,” Plate Analysis”, Khanna Publisher, New Delhi.
5. Ramaswamy. G.S,” Design and Construction of Concrete Shell Roofs”, Mc GrawK.Chandrasekhara

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Professional Elective - II

ADVANCEMENTS IN CONCRETE TECHNOLOGY

I Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- To become familiar to latest types, properties and applications of cements and admixtures
- build the knowledge on different types of prospecting aggregates
- impart knowledge on characteristics of quality, durability and concrete construction.
- familiarize with latest technology developments in construction

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the properties and applications of latest cements and admixtures.
- identify the suitability of different types of prospecting aggregates and their use.
- determine the role Quality and durability of concrete in concrete construction
- explain about special processes in concreting.
- enumerate the usage of concrete coatings and surface treatments.

Course Content

UNIT–I: Cements

Review of cements including blended and special cements, manufacture, chemical composition, chemical and physical processes of hydration, modern methods of analysis.

UNIT–II: Admixtures

Review of types and classification; chemical composition; origin and manufacture; actions and interactions; usage; effects on properties of concretes, mortars and grouts; applications.

UNIT–III: Aggregates

Review of types; elementary mineralogy and petrology; aggregate prospecting; production of artificial aggregates; sampling and testing.

UNIT–IV: Quality, Durability of Concrete and Concrete Construction

Quality of mixed concrete: outline of problems involved; control techniques; selection of control procedures. Quality of finished product- Durability concept; pore structure and transport processes; reinforcement corrosion Chloride attack sulphate attack - Fire resistance; frost damage; alkali-silica reaction; methods of providing durable concrete;

UNIT–V: Special Processes and Technology for Particular Types of Structure

Sprayed concrete; underwater concrete; grouts, grouting and grouted concrete; mass concrete; slip-form construction; pumped concrete; concrete for liquid retaining structures; vacuum process.

Text Books

1. Concrete Technology, M.S.Shetty, Edition -2006, S.Chand& Co.
2. Properties of Concrete, A.M.Neville, 5thedition(2012), Pearson.

Reference Books

1. Concrete Technology, M.L.Gambhir, 3rd edition TataMc.Graw Hill Publishers, New Delhi
2. Concrete Technology by A.R. Santha Kumar, Edition-2013, Oxford UniversityPress, New Delhi.
3. Design of Concrete Mixes by N.Krishnam Raju,2nd edition,CBS Publishers &Distributors
4. IS 456:2016 Plain and Reinforced Concrete - Code of Practice.
5. CONCRETE – Microstructure, properties and materials, fourth edition, P.Kumar Mehta/ Paulo J.M. MONTEIRO, McGraw Hill Education (india) Private limited, Chennai.

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Professional Elective - II

DESIGN OF PRE-STRESSED CONCRETE STRUCTURES

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- understand the basics of elements of prestressed concrete, systems, analysis and design of various elements of prestressed concrete structures subjected to flexure, shear, torsion and axial tension.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the basic aspects of pre stressed concrete, and analyze the pre stressed concrete beams for flexure
- calculate losses in the pre stressed concrete and deflections of uncracked members.
- transfer of prestress in pre-tensioned and post-tensioned members and design of end blocks with anchorage zone reinforcement.
- design of prestressed concrete members for flexure axial tension, shear and torsional members.
- design of prestressed concrete slabs.

Course Content

UNIT–I: Introduction to Pre-stressed Concrete

Introduction, Tensioning devices, Pretensioning and Post –tensioned Systems, Basic assumptions, Analysis of Prestress, Resultant Stresses at a section, Pressure line and internal resisting couple, load balancing concept, stresses in tendons and Cracking Moments.

UNIT–II: Losses of Prestress and Deflections

Nature of Losses of prestress in pretension and post-tension, total losses allowed for in design, importance of control of deflections, factors, short-term deflections of uncracked members, long-time deflections and requirements of various codes of practice.

UNIT–III: Transmission of Pre-stresses

Transmission of prestressing force by bond, transmission length, bond stresses, transverse tensile stresses, end-zone reinforcement, flexural-bond stresses, stress distribution in end block, investigations on anchorage zone stresses and reinforcement.

UNIT–IV: Limit State Design of Strucures

Philosophy and criteria of limit-state design, design loads and strengths, serviceability limit states, crack widths and principles of dimensioning of prestressed concrete members, design of sections for flexure, axial tension, shear and torsion.

UNIT–V: Design of Slabs

Types of prestressed concrete floor slabs, design of prestressed concrete one-way slab, two-way slab and simple flat slabs.

Text Books

1. T.Y. Lin, "Design of Pre-stressed Concrete Structures", Asia Publishing House, 2010.
2. N. Krishna Raju, "Pre-stressed Concrete", Tata McGraw Hill, New Delhi, 2018.

Reference Books

1. Edward G. Nawy, "Prestressed Concrete A Fundamental Approach",fifth edition, Prentice Hall.
2. Y. Guyan, "Limit State Design of Pre stressed Concrete", Applied Science Publishers, 1972.
3. IS: 1343- Code of Practice for Prestressed Concrete.

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Professional Elective - III

ADVANCED DESIGN OF STEEL STRUCTURES

II Semester

Lecture	: 3		Internal Marks	:	30
Credits	: 3		External Marks	:	70

Course objectives

To make the students

- To impart the concepts of designing water tanks, bridges, transmissiontowers and chimneys.
- To familiarize on plastic behavior, plastic moment and plastic mechanismof steel structures like simple beams and portal frames.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the design principles to elevated steel water tanks.
- identify the configuration of truss bridges and understand the design
- principles of truss elements.
- develop the methodology of designing transmission line tower structures.
- understand the design concepts of self-supporting chimneys & foundations.
- develop confidence levels in understanding the plastic analysis, plastic
- mechanism and apply to simple beams & frames.

Course Content

UNIT – I: Water Tanks

Design of elevated water storage steel tanks – Rectangular/pressed steel tanks – Stays in pressed steel tanks , accessories and staging – Permissible stresses— simple problems.

UNIT – II: Truss Bridges

Through type truss bridges (Pratt type only) - component parts of a truss bridge- self weight of truss girders- assumptions for design of truss bridges - Design of compression and tension members, top & bottom lateral bracings and top portal bracing.

UNIT – III: Towers

Introduction, Loads on towers-shape, sag, and tension in uniformly loaded conductors- Analysis of towers- Masts- Trestles- Stresses in trestles due to vertical and horizontal loads- design of members in towers- design of tower foundation.

UNIT – IV: Chimneys

Introduction, Dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability considerations. Design procedure only.

UNIT – V: Plastic Analysis

Plastic analysis of steel structures – Plastic bending in beams, collapse mechanism – Fully plastic Moment – Shape factor and Plastic moment – Ultimate load carrying capacity of simple beams and portal frames.

Note: Designs are by limit state method as per IS 800-2007.

Text Books

1. Design of steel structures vol II Dr. Ramachandra, Standard Book House
2. B.C.Punmia, Ashok kumarjain&Arunkumarjain "Comprehensive Design of steel structures" Laxmi publications, New Delhi.

Reference Books

1. A.S.Arya&J.L.Ajmani "Design of Steel Structures" Nemchand& Brothers, New Delhi.
2. P.Dayaratnam "Design of Steel Structures" Wheeler publishing, New Delhi.
3. V.N.Vazirani&M.M.Ratwani "Steel Structures" Khanna publications, New Delhi.
4. Relevant steel codes of Bureau of Indian standard.

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Professional Elective - III

STABILITY OF STRUCTURES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course objectives

To make the students

- To impart the knowledge on linear and nonlinear behavior of structures.
- To familiarize the student with stability of plates under combined loads.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze these structures with linear and nonlinear behavior.
- gain the knowledge on Stability of Continuous systems.
- distinguish between elastic buckling and in- elastic buckling.

Course Content

UNIT–I: Criteria for Design of Structures

Concept of stability, strength, and stiffness - Stability of discrete systems - Linear and nonlinear behavior.

Beam Columns: Differential equation for beam columns – Beam column with concentrated loads – Continuous with lateral load – Couples – Beam column with built in ends – Continuous beams with axial load – Determination of allowable stresses.

UNIT–II: Elastic Buckling

Elastic buckling of bars: Elastic buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns –Sway & Non-Sway mode - Energy methods – Buckling of a bar on elastic foundation – Buckling of bars with change in cross section – Effect of shear force on critical load – Built up columns – Effect of Initial curvature on bars – Buckling of frames – Sway & Non-Sway mode.

UNIT–III: In-Elastic Buckling

In-elastic buckling: Buckling of straight bars – Double modulus theory, Tangent modulus theory. Empirical formulae of design – various end conditions– Design of columns based on buckling. Rayleigh Ritz method – Stiffness method and formulation of Geometric stiffness matrix- Applications to simple frames.

UNIT–IV: Torsional Buckling

Torsional Buckling: Pure torsion of thin-walled bars of open cross section – Non uniform torsion of thin-walled bars of open cross section - Torsional buckling – Buckling on Torsion and Flexure.

UNIT–V: Lateral Buckling

Lateral Buckling of simply supported Beams: Beams of rectangular cross section subjected for pure bending, Buckling of I Section subjected to pure bending.

Text Books

1. Principles of Structural Stability Theory by Alexander Chajes, P H I Publications.
2. Theory of Elastic stability by Timshenko & Gere-McGraw Hill Publications.

Refernce Books

1. An introduction to the elastic stability of structures by Simitses,G.J., 2nd Edition, Prentice Hall.
2. Stability of structures by Bazant, Z.P. and Cedolin, L., 1st Edition, OxfordUniversity Press, Oxford.
3. Buckling of Bars, Plates and Shells by Brush, B.O., and Almoroth,B.O., 3rd Edition, McGraw Hill, NY.
4. Guide to stability design criteria for metal Structures by Galambos,T.V., 2nd Edition,Wiley, NY.

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Professional Elective - III

DESIGN OF HIGH-RISE STRUCTURES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course objectives

To make the students

- To study the behavior, analysis and design of tall structures.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the behavior of tall buildings due to various types of loads.
- analyze and design such buildings by approximate, accurate and simplified methods.

Course Content

UNIT–I: Loading and Design Principles

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - limit state method. Codal provisions.

UNIT–II: Behaviour of Various Structural Systems

Factors affecting growth, height and structural form. High rise behavior, Rigid frames, braced frames, shear walls, coupled shear walls.

UNIT–III: Analysis and Design

Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction. Analysis using substitute frame method for gravity loads and approximate methods for lateral loads.

UNIT–IV: Structural Elements

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design procedure for differential movement, creep and shrinkage effects.

UNIT–V: Stability Issues

Application of software in analysis and design of multi- storied building/ chimney/ transmission tower.

Text Books

1. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986
2. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.

Reference Books

1. .Lin T.Y.and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”,

2.John Wiley, 1985.5.Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

3.Is code for tall buildings.

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Professional Elective - IV

DESIGN OF BRIDGE STRUCTURES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course objectives

To make the students

- Impart overall knowledge on analysis and design of RC bridges
- Familiarize students with the knowledge of bridge sub structure and bearings

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain the knowledge on requirements of major bridges
- design deck slab bridges
- acquire knowledge on design of pier and abutment
- design the Bridge bearings
- gain the knowledge on well foundations

Course Content

UNIT–I: Investigation on Major Bridges

Coverage; Topographical details; Catchment area map; Hydrological particulars; Geotechnical details; Seismology of the area; Navigational requirements; Construction resources; selection of suitable site for construction of a bridge; Traffic forecast.

UNIT–II: Reinforced Concrete Slab Bridge Decks

General features, design coefficients, analysis of slab decks, design aids, minimum reinforcements, design of reinforced concrete culverts for IRC class AA & class A loads.

UNIT–III: Piers And Abutments

Types of piers and abutments; Materials of construction; Design of a pier and abutment.

UNIT–IV: Bearings

Classification of bearings; Guidelines for selection of bearings; Design considerations; Basis for metallic bearings; Ferrous bearings of traditional type; Design of elastomeric bearings

UNIT–V: Bridge Foundations

Types of foundations- Well foundation, open well foundation, components of well foundation – Pile foundations (designs not included) – Reinforcement detailing and bar bending schedule need to be prepared

Text Books

1. "Design of Bridges" by Krishna Raju N., 4th edition, Oxford and IBH Publishing Co., Ltd. (Units II, III, IV & V)
2. "Bridge Engineering" by PonnuSwamy, 4th edition, McGraw-Hill Publications (Units I).

References Books

1. "Essentials of Bridge Engineering" by Johnson victor D, 7th edition, Oxford, IBH Publishing Co., Ltd.
2. "Design of Concrete Bridges" by Vazirani, Ratvani&Aswani, 5th edition, Khanna Publishers.
3. "Analysis and Design of sub-structures" by Swami Saran, 2nd edition, Oxford IBH Publishing co ltd.

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Professional Elective - IV

REPAIRS AND RETROFITTING OF STRUCTURES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- To familiarize with durability accepts, quality of concrete causes of deterioration.
- To impart the knowledge on inspection and assessment of distressed structures, strengthen measures.
- To familiarize with various concrete materials for repairs and various precautions during retrofitting.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify and evaluate the degree of damage in structures.
- point out the causes of distress in concrete.
- evaluate the existing buildings through field investigations.
- develop various maintenance and repair strategies.
- understand and use the different techniques for health monitoring.

Course Content

UNIT–I: Deterioration of Structures

Introduction – Deterioration of Structures – Distress in Structures – Causes and Prevention. Mechanism of Damage – Types of Damage.

UNIT–II: Corrosion of Steel Reinforcement

Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation.

UNIT–III: Inspection & Testing

Inspection and Testing – Symptoms and Diagnosis of Distress – Damage assessment – NDT.

UNIT–IV: Repair of Structures

Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shotcrete – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

UNIT – V: Structural Health Monitoring

Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

Text Books

1. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
2. Concrete Technology by A.R. Santakumar, Oxford University press.

References Books

1. Defects and Deterioration in Buildings, EF & N Spon, London.
2. Non-Destructive Evaluation of Concrete Structures by Bungey – Surrey University Press.
3. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W.H. Ranso, (1981).
4. Building Failures: Diagnosis and Avoidance, EF & N Spon, London, B.A. Richardson, (1991).

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Professional Elective - IV

GROUND IMPROVEMENT METHODS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- To identify weak soils, suggest suitable improvements methods and to be familiar with the equipment's used for improvement.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the parameters of weak soil and the techniques used for treating such soils.
- dnow various types of stabilizers, stabilization techniques and its application in the field.
- dnow the environmental sustainability of each method.
- dnow various types of Grouting techniques
- acquire knowledge for application of grouting methods in the field

Course Content

UNIT–I: Dewatering

Introduction – Scope and necessity of ground improvement – New Technologies – Basic concepts – Drainage methods – Ground water lowering by well points – Deep well, Vacuum and Electro – Osmosis methods.

UNIT–II: Compaction and Sand Drains

In-situ compaction of cohesionless and cohesive soils – Shallow and deep compaction – Vibration methods – Vibro-compaction, Blasting, vibrating probe, Vibratory rollers, Vibro-displacement compaction, Vibroflotation – Concept, Factors influencing compaction – Heavy Tamping – Vertical drains – Preloading with sand drains, Fabric drains, Wick drains – Design of sand drains – Relative merits of different methods – Limitations.

UNIT–III: Stone Column and Consolidation

Precompression and consolidation – Dynamic consolidation – Electro-osmotic consolidation – Stone column – Functions – Methods of installation – Design estimation of load carrying capacity of stone column – Settlement of stone column – Lime piles – Earth reinforcement – Soil Nailing – Types of reinforcement material – Applications.

UNIT–IV: Stabilization

Introduction – Stabilization methods – Mechanical, Cement, Lime, Bitumen, Chemical stabilization – Electrical stabilization – Stabilization by Thermal and Freezing techniques – Ground improvement by excavating and replacing – Stabilization of expansive clays – Prewetting.

UNIT – V: Grouting

Introduction – Applications – Functions – Characteristics of grouts – Types of grout – Suspension and solution grouts – Basic requirements of grout – Displacement – Compaction grouting, displacement – Soil fracture grouting, Jet – Displacement grouting, Permeation grouting – Grouting equipment – Injection methods – Grout monitoring.

Text Books

1. Moseley M.D., Ground Treatment, Blackie Academic and Professional, 1998
2. Shroff, A.V., Grouting Technology, in Tunneling and Dam, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.

Reference Books

1. Purushothama Raj, P., Ground Improvement Techniques, Laxmi Publications (P) Ltd., New Delhi, 2005
2. Koerner, R.M., Designing with Geosynthetics (fourth edition), Prentice Hall, New Jersey, 1999.

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Professional Elective - V

EARTHQUAKE RESISTANT DESIGN FO STRUCTURES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- impart the knowledge of designing earthquake resistant structures and
- familiarize the codal provisions and carry out an analytical problem.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe various terms of engineering seismology.
- design earthquake-resistant structures by using different methods.
- gain the knowledge on seismic codal provisions and detailing
- identification of damages and non- damages in masonry buildings
- acquire the knowledge on properties of structural masonry

Course Content

UNIT–I: Engineering Seismology

Introduction, Types of earthquakes, effects and causes of earthquakes, magnitude & intensity, fault rupture parameters, Local site effects.

UNIT–II: Codal Provisions and Design of Lateral Loads

Review of Indian Seismic code IS: 1893 – 2016 (Part- I) provisions- Earthquake design philosophy.

Introduction - Design forces for buildings by Equivalent static method and Response spectrum method.

UNIT–III: Ductility Considerations in Designof RC Buildings

Introduction, impact of ductility, requirements for ductility, assessment of ductility, factors effecting ductility, ductility factors, ductility consideration as per IS:13920:2016.

UNIT–IV: Damages and Non-Damages in Masonary Buildings and Properties of Structural Masonary

Introduction, past Indian earthquakes, Features of damages and non-damages- Bhuj earthquake, Chamoli earthquake, Bihar –Nepal earthquake, Uttarkashi earthquake.

Introduction, materials for masonry construction-unit, mortar, grout, reinforcement.

UNIT – V: Masonry Buildings

Introduction, determination of design lateral loads, distribution of lateral forces, determination of rigidity of shear force, determination of direct shear force and torsional shear forces.

Text Books

1. "Earthquake Resistant Design of Structures" by pankaj Agarwal &shrikhandeManish ,Eswar Press.
2. "Earthquake Resistant Design of Structures", by Duggal S.K., Oxford UniversityPress,2nd Edition.

Reference Books

1. "Dynamics of Structures by Anil K. Chopra, Theory and Applications to Earthquake Engineering", 4 th Edition, Prentice Hall of India.
2. Elements of Earthquake Engineering", Jai Krishna AR Chandrasekharan,andBrijesh Chandra 3rd Edition, SarithaPrakasham, Meerut.
3. "Relevant Indian Standard Codes: IS-875, IS-1893, IS -4326, IS- 13920.

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Professional Elective - V

DESIGN OF SUB-STRUCTURES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- impart the knowledge on soil exploration and design principles of shallow and pile foundations.
- introduce vibration concept in soils.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain the knowledge on method of soil exploration.
- evaluate the bearing capacity of soil.
- gain the knowledge on mode of vibration and analysis of machine foundation.
- gain the knowledge on concept of load carrying capacity of pile group.

Course Content

UNIT–I: Soil Exploration

Soil Exploration – Importance, terminology, methods of boring. Soil sampling – Types of samples, design considerations of open drive samplers.

UNIT–II: Shallow Foundations

Shallow Foundations –Bearing capacity – Terzaghi's, Meyerhof's, Hansen's, Vesic's and IS code methods- Bearing capacity based on standard penetration.

UNIT–III: Footings

Principle of design of footing, proportioning footings for equal settlement, mat foundation - Rectangular and trapezoidal combined footings, common type of Raft foundations, bearing capacity and differential settlement of mat foundation.

UNIT–IV: Pile Foundations

Pile foundations-Classification of piles-factors influencing choice-Load carrying capacity of single pile in clayey and sandy soils using static & dynamic pile formulae- Group of piles – Pile cap - Efficiency of pile groups- load carrying capacity and settlement of pile groups in cohesive and non-cohesive soils.

UNIT–V: Vibrations in Soils

Fundamentals of Vibration; Free and Forced Vibration with and without damping; Natural frequency of foundation; Types of machine foundation; I.S. Code of practice for design and construction of block foundation for reciprocating and impact type machines for high-speed rotary machines.

Text Books

1. Braja M. Das," Principles of Foundation Engineering", CengageLearing.
2. J.E. Bowles," Foundation Analysis and Design", McGraw Hill Publishing Co.,

Reference Books

1. K. R. Arora,"Soil Mechanics and Foundation Engineering", standard publishers and Distributors, Delhi.
2. Terzagi and Peck, "Soil Mechanics in Engineering Practice", John wiley & sons.
3. Wayne C. Teng, "Foundation Design", Prentice – Hall. Swami Saran, "Analysis and Design of sub structures", Oxford & IBH.

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Open Elective

SUSTAINABLE DEVELOPMENT

III Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- understand the students understand the fundamental key concepts on Sustainable Development (SD),suchasintra-andinter-generational equity, economic, social and environmental,sustainability, strong and weak sustainability, natural capitalism, steady state and green economy.
- to identify and discuss in detail the key empiricalissues on sustainable development, such as renewable energy transitions, urban agriculture and green architecture.
- expertise to distinguish between “greeneconomy” and “sustainability” and various efforts at multiple levels ofgovernance:from individual to governments.
- expose to awide varietyof research areas to apply and therefore appropriate the oretical knowledge on public policy and international relations to the issue area of sustainable development, insuch aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance.
- empower to make their own lives more sustainable and join social movements to bring about more of sustainable development.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain knowledge of sustain ability and bio diversity
- study about greenhouse gases
- learn dynamics of sustainability
- gain Knowledge on socio-economic systems
- study about the conventions on sustainable development
- learn concept of Sustainable Development and itsrole in building of environment

Course Content

UNIT–I: Concept of Sustainable Development

Definition of sustainability - History and emergence of the concept of Sustainable development – Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Glo balization and environment - Population, Poverty and Pollution –Global, Regional and Local environmental issues–Resource Degradation–Greenhouse gases and climate Change – Desertification – Industrialization –Socialinsecurity.

UNIT–II: Sustainability and thetriple bottom line

Components of sustainability–Complexity of growth and equity-Social, economic and environmental dimensions of sustainable development–Environment–Biodiversity–Natural Resources–Ecosystem integrity–Clean air and water–Carrying capacity–Equity, Quality of Life, Prevention, Precaution, Preservation and Public participation. - Structural and functional linking of developmental dimensions – Sustainability in national and regional context..

UNIT–III: Sustainable Development and International Response

Role of developed countries in the development of developing countries–International summits–Stock holm to Johannes burg–Rio Principles–Agenda 21-Conventions–Agreements–Tokyo Declaration-Doubling Statement - Trans boundary issues – Integrated approach for resource protection and management.

UNIT–IV: Sustainable Development of Socio-Economic Systems

Demographic dynamics of sustainability – Policies for socio-economic development –Strategies for implementing eco-development programmes – Sustainable development through trade – Economic growth – Action plan forimplementing sustainable development – Urbanization and Sustainable Cities –Sustainable Energy and Agriculture –Sustainable Livelihoods – Ecotourism.

UNIT–V: Framework for Achieving Sustainability

Sustainability indicators - Hurdles to Sustainability - Operational guidelines – Inter connected pre-requisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry-Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Text Books

1. Austin, James and Tomas Kohn. 1990. Strategic Management in DevelopingCountries.TheFreePress.
2. Berger. 1994. “The Environment and the Economy.” In Smelser and Swedberg(eds.)
3. TheHandbookofEconomicSociology.RusselSageFoundation.D’Arcy,David. Transcript of broadcast, Dec. 5, 2002, “In Houston, a Treasure of ExiledAfghanArt,”National PublicRadio,

Reference Books

1. Elkington, John. Cannibals with Forks:TheTriple Bottom Line for 21stCenturyBusiness Oxford:Capstone Publishing,October 1997.
2. Guillen, Mauro and Sandra L. Suarez. 2002. “The Institutional Context of Multinational Activity.”In Organization Theory and the Multinational Corporation” .2ndedition. New York: St.Martin’s Press.

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Open Elective

ENERGY AUDIT, CONSERVATION & MANAGEMENT

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- To learn principle of energy audit as well as management for industries and utilities and buildings.
- To study the energy efficient motors and lighting.
- To learn power factor improvement methods and operation of different energy instruments.
- To compute depreciation methods of equipment for energy saving.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the principle of energy audit and their economic aspects.
- recommend energy efficient motors and design good lighting system.
- understand advantages to improve the power factor.
- evaluate the depreciation of equipment.

Course Content

UNIT–I: Basic Principles of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT–II: Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language,Questionnaire – check list for top management.

UNIT–III: Energy Efficient Motors and Lighting

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed , variable duty cycle systems, RMS - voltage variation-voltage unbalanceover motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit.

UNIT–IV: Power Factor Improvement and Energy Instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers,application of PLC s.

UNIT–V: Economic Aspects and their Computation

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Text Books

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John Wiley and sons, 1982.

Reference Books

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

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Open Elective

RAPID PROTOTYPING

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- familiarize with Rapid Prototype tools and techniques for design and Manufacturing.

Course Outcomes

Upon successful completion of the course, the students will be able to

- assess the need of RPT in Product development.
- use appropriate RT Software for development of Prototype model.
- judge the correct RP Process for Product/Prototype development.
- predict the technical challenges in 3D printing.
- list the applications of RPT.

Course Content

UNIT–I: Introduction to Rapid Prototyping

Introduction to prototyping, traditional prototyping Vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

UNIT–II: RP Software and Software Issues of RP

RP Software: Need for RP software, MIMICS, magics, surgiGuide, 3D-doctor, simplant, velocity2, voxim, solidView, 3Dview, etc., software.

Software Issues of RP: Preparation of CAD models, problems with STI, files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT–III: Photopolymerization RP Processes, Powder Bed Fusion RP Processes and Extrusion-Based RP Systems

Photopolymerization RP Processes: Sterolighography (SL), SL resin curing process, SL scan patterns, microstereolithography, applications of photopolymerization processes.

Powder Bed Fusion RP Processes: Selective laser sintering (SLS), powder fusion mechanism and powder handling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes.

Extrusion-Based RP Systems: Fused deposition modelling (FDM), principles, plotting and path control, applications of extrusion-based processes..

UNIT–IV: Printing RP Processes, Sheet Lamination RP Processes and Beam Deposition RP Processes

Printing RP Processes: 3D printing (3DP), research achievements in printing deposition, technical challenges in printing, printing process modeling, applications of printing processes.

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications.

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), processing – structure - properties, relationships, benefits and drawbacks.

UNIT–V: Rapid Tooling, Errors in RP Processes and RP Applications

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, classification of rapid tooling, direct and indirect tooling methods, soft and hard tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, part building errors in SLA, SLS, etc.,

RP Applications: Design, engineering analysis and planning applications, rapid tooling, reverse engineering, medical applications of RP.

Text Books

1. Chua Chee Kai., Leong KahFai., Chu Sing Lim, “Rapid Prototyping: Principles and Applications in Manufacturing”, World Scientific

Reference Books

1. Ian Gibsn., David W Rosen., Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
2. Pham, D.T, Dimov, S.S, Rapid Manufacturing, Springer, 2001.

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Open Elective

AUTOMOTIVE ELECTRONICS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- familiarize with the electronic systems inside automotive vehicle.
- introduce with the concepts of advanced safety systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- learn the fundamentals of automotive technology.
- describe the operation of microcomputer systems.
- acquire knowledge in automotive sensors and control systems.
- develop communications & navigation/routing in automotive vehicles.

Course Content

UNIT–I: Automotive Fundamentals

Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.

UNIT–II: Automotive Micro-Computer System

Binary number system, binary counters, Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory-ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram.

UNIT–III: Basics of Electronics Engine Control

Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.

UNIT–IV: Sensors and Actuators

Introduction; basic sensor arrangement; types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, actuators – fuel metering actuator, fuel injector, and ignition actuator.

UNIT–V: Electronic Vehicle Management System and Automotive Instrumentation System

Cruise control system, antilock braking system, electronic suspension system, electronic steering control, and transmission control, safety: air bags, collision avoidance radar warning system with block diagram, low tire pressure warning system, advanced cruise control system.

Speech synthesis, sensor multiplexing, control signal multiplexing with block diagram, fibre optics inside the car, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialling.

Text Books

1. William B. Ribbens, “Understanding Automotive Electronics”, SAMS/Elsevier Publishing, 6th Edition. (UNITS I -V).
2. Robert Bosch Gambh, “Automotive Electrics Automotive Electronics Systems and Components”, John Wiley& Sons Ltd., 5th edition, 2007.

Reference Books

1. Ronald K Jurgen, “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill, 1999.
2. G. Meyer, J. Valldorf and W. Gessner, “Advanced Microsystems for Automotive Applications”, Springer, 2009.
3. Robert Bosch, “Automotive Hand Book” SAE, 5th Edition, 2000.

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Open Elective

SOFT COMPUTING TECHNIQUES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

To make the students

- Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- Introduce students to artificial neural networks and fuzzy theory from an engineering perspective

Course Outcomes

Upon successful completion of the course, the students will be able to

- comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- reveal different applications of these models to solve engineering and other problems.

Course Content

UNIT–I: Fuzzy Set Theory

Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Surgeon Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

UNIT–II: Optimization

Derivative based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing and Random Search – Downhill Simplex Search..

UNIT–III: Artificial Intelligence

Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Prepositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning under Uncertainty Basic knowledge Representation Issues Knowledge acquisition, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent directed Search Production System and Learning.

UNIT–IV: Neuro Fuzzy Modeling

Adaptive Neuro-Fuzzy Inference Systems, Architecture – Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT–V: Applications of Computational Intelligence

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.

Text Books

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2006.

Reference Books

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.

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Professional Elective - I

MODERN CONTROL THEORY

I Semester

Lecture	: 3		Internal Marks	:	30
Credits	: 3		External Marks	:	70

Course Objectives

- To familiarize the concepts of state variables analysis.
- To impact the knowledge on design of control systems using state variable techniques.
- To familiarize students with stability methods of non-linear systems.
- To introduce the fundamental concepts on optimal control theory.

Course Outcomes

Upon successful completion of the course, the students will be able to

- formulate and solve the various state space representations of dynamic systems.
- examine a system for its controllability and observability.
- design a state feedback controller and an observer.
- analyze the behavior of non-linear systems through describing functions.
- determine the stability of a given system using various state variable techniques.
- design an optimal control system using variational approach.

Course Content

UNIT – I: State Variable Analysis

The concept of state – State Equations for Dynamic systems– Solution of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it s properties. Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model.

UNIT – II: Design using state variable Technique

Design of state feedback controller through pole placement technique-Necessary and sufficient condition- Ackermann s formula. Concept of observer-Design of full order state observer-reduced order observer.

UNIT – III: Non Linear Systems

Classification of Nonlinearities- common physical nonlinearities– Characteristics of nonlinear systems - Singular Points –Linearization of nonlinear systems– Describing function – describing function analysis of nonlinear systems- Stability analysis of Nonlinear systems through describing functions.

UNIT – IV: Stability Analysis

Stability in the sense of Lyapunov, Lyapunov s stability and Lyapunov s instability theorems – Stability Analysis of Linear Continuous time invariant systems by Lyapunov method – Generation of Lyapunov functions – Variable gradient method – Krasooviski s method.

UNIT – V: Introduction to Optimal Control

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler Lagrangine equation.

Typical optimal control performance measures-optimal control based on Quadratic performance measures- Quadratic optimal regulator systems- State regulator problems –Output regulator problems, tracking problems; Riccati equation-Infinite time regulator problem-Reduce matrix Riccati equation determination of optimal feedback gain matrix.

Text Books

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication.

Reference Books

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2 Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
6. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India,2009

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Professional Elective - I

POWER QUALITY AND CUSTOM POWER DEVICES

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand significance of power quality and power quality parameters.
- To know types of transient over voltages and protection of transient voltages.
- To understand harmonics, their effects, harmonic indices and harmonic minimization techniques.
- To understand the importance of power devices and their applications.
- To understand different compensation techniques to minimize power quality disturbances.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the issues related to power quality in power systems.
- address the problems of transient and long duration voltage variations in power systems.
- analyze the effects of harmonics and study of different mitigation techniques.
- identify the importance of custom power devices and their applications.
- acquire knowledge on different compensation techniques to minimize power quality disturbances.

Course Content

UNIT – I: Introduction to Power Quality

Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT – II: Transient and Long Duration Voltage Variations

Source of Transient Over Voltages - Principles of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor Switching Transients, Utility Lightning Protection, Load Switching Transient Problems. Principles of Regulating the Voltage, Device for Voltage Regulation, Utility Voltage Regulator.

Application, Capacitor for Voltage Regulation, End-user Capacitor Application, Regulating Utility Voltage with Distributed generation.

UNIT – III: Harmonic Distortion and Solutions

Voltage vs. Current Distortion, Harmonics vs. Transients – Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics, Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion

Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics.

UNIT – IV: Custom Power Devices

Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT – V: Application of Custom Power Devices in Power Systems

Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic VoltageRestorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and control of Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner.

Text Books

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
3. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000.
4. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.

Reference Books

1. Park & Paulay, "Reinforced Concrete", John Wiley & sons Publications.
1. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
4. Power Quality C. Shankaran, CRC Press, 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis).
6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S.Masoum-Elsevier
7. Power Quality, C. Shankaran, CRC Press, 2001
8. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
9. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002
10. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.

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Professional Elective - I

PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle analog signal and converting of A/D in PLC.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the PLCs and their I/O modules.
- develop control algorithms to PLC using ladder logic etc.
- manage PLC registers for effective utilization in different applications.
- handle data functions and control of two axis and their axis robots with PLC.
- design PID controller with PLC.

Course Content

UNIT – I: PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT – II: PLC Programming

Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT – III: PLC Registers

Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT – IV: Data Handling Functions

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axis and three axis Robots with PLC, Matrix functions.

UNIT – V: Analog PLC operation

Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

Text Books

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A.Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

Reference Books

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

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Professional Elective - II

ARTIFICIAL INTELLIGENCE TECHNIQUES

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

Course Outcomes

Upon successful completion of the course, the students will be able to

- differentiate between Algorithmic based methods and knowledge based methods.
- use appropriate AI framework for solving power system problems.
- design fuzzy logic controllers for power engineering applications.

Course Content

UNIT – I: Introduction

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability-XOR function.

UNIT – II: ANN Paradigms

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT – III: Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations,Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT – IV: Fuzzy Logic Controller (FLC)

Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets-Defuzzification methods.

UNIT – V: Application of AI Techniques

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm,single area and two area load frequency control using fuzzy logic.

Text Books

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

Reference Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran and G.A.Vijayalakshmi Pai – PHI Publication.
2. Modern power Electronics and AC Drives – B.K.Bose -Prentice Hall, 2002
3. Genetic Algorithms- David E Goldberg. Pearson publications.
5. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH
6. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam,SSumathi,S N Deepa Springer,2007.

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Professional Elective - II

RENEWABLE ENERGY TECHNOLOGIES

I Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn technical challenges in renewable energy.
- To learn basics of wind energy conversion & PV power generation.
- To analyze the fuel cell system.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand various general aspects of renewable energy systems.
- analyze and design induction generator for power generation from wind.
- design MPPT controller for solar power utilization.
- utilize fuel cell systems for power generation

Course Content

UNIT – I: Introduction

Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems.

UNIT – II: Induction Generators

Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation – Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control.

UNIT – III: Wind Power Plants

Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation- General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

UNIT – IV: Photovoltaic Power Plants

Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance - input-output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

UNIT – V: Fuel Cells

The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange,Membrane Fuel Cells; Reformers; Electrolyzer Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage.

Text Books

1. Felix A. Farret, M. Godoy Simo‘ es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.

Reference Books

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

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Professional Elective - II

FLEXIBLE AC TRANSMISSION SYSTEMS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To Introduce the Flexible AC Transmission System devices, basic types of FACTS controllers and different types of converters and their operation in different modes.
- To expose the practical problems associated with the operation of Power system and the necessity of FACTS devices

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the Fundamental concepts of FACTS Devices.
- familiarize with the operational characteristics of Voltage source converters used in FACTS devices.
- identify a suitable FACTS controller for shunt compensation.
- familiarize with the control characteristics FACTS devices.
- Identify and design a suitable controller using FACTS Devices for Series compensation.

Course Content

UNIT–I: FACTS Concepts

FACTS concepts, Transmission interconnections, power flow in an AC System, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

UNIT–II: Voltage Source Converters

Single phase, three phase, full wave bridge converters, transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source converters, and comparison of current source converters with voltage source converters.

UNIT–III: Static Shunt Compensation

Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable var generation, variable impedance type static var generators, switching converter type var generators, hybrid var generators.

UNIT–IV: SVC and STATCOM

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

UNIT–V: Static Series Compensators

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

Text Books

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition is available—Standard Publications (Units I to V)

Reference Books

1. HVDC & FACTS Controllers applications of static converters in power systems - Vijay K.Sood- Springer publishers.
2. Sang.Y.H and John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).

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Professional Elective - III

CONTROL & INTEGRATION OF RENEWABLE ENERGY SYSTEMS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course objectives

- To understand different conventional & non-conventional dynamic energy conversion technologies.
- To learn the principles of static energy conversion technologies.
- To understand the basics of real & reactive power control with renewable generators.
- To learn the principles of standalone and grid connected systems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gain knowledge on different renewable energy sources and storage devices
- recognize, model and simulate different renewable energy sources
- analyze, model and simulate basic control strategies required for grid connection
- implement a complete system for standalone/grid connected system

Course Content

UNIT – I: Introduction

Electric grid introduction, Supply guarantee and power quality, Stability, Effects of renewable energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns, static and dynamic energy conversion technologies, interfacing requirements.

UNIT – II: Dynamic Energy Conversion Technologies

Introduction to different conventional and nonconventional dynamic generation technologies, principle of operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies, control and integrated operation of different dynamic energy conversion devices.

UNIT – III: Static Energy Conversion Technologies

Introduction to different conventional and nonconventional static generation technologies, principle of operation and analysis of fuel cell, photovoltaic based generators, and wind based generation technologies, different storage technologies such as batteries, fly wheels and ultra-capacitors, plug-in-hybrid vehicles, control and integrated operation of different static energy conversion devices.

UNIT – IV: Real and Reactive Power Control

Control issues and challenges in Diesel, PV, wind and fuel cell based generators, PLL, Modulation Techniques, Dimensioning of filters, Linear and nonlinear controllers, predictive controllers and adaptive controllers, Fault-ride through Capabilities, Load frequency and Voltage Control.

UNIT – V: Integration of different Energy Conversion Technologies

Resources evaluation and needs, Dimensioning integration systems, Optimized integrated systems, Interfacing requirements, integrated Control of different resources, Distributed versus Centralized Control, Synchro Converters, Grid connected and Islanding Operations, stability and protection issues, load sharing, Cases studies.

Text Books

1. Ali Keyhani Mohammad Marwali and Min Dai, "Integration and Control of Renewable Energy in Electric Power System" John Wiley publishing company
2. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", IET Power Electronics Series, 2012
3. G. Masters, "Renewable and Efficient Electric Power Systems", IEEE-Wiley Publishers, 2013

Reference Books

1. Quing-Chang Zhong, "Control of Power Inverters in Renewable Energy and Smart Grid Integration", Wiley, IEEE Press
2. Bin Wu, Yongqiang Lang, NavidZargari, "Power Conversion and Control of Wind Energy Systems", Wiley 2011.

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Professional Elective - III

HYBRID ELECTRIC VEHICLES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn the concept of hybrid vehicles, types of electric drives used in hybrid vehicles and their control.

Course Outcomes

Upon successful completion of the course, the students will be able to

- know the concept of electric vehicles and hybrid electric vehicles.
- familiar with different motors used for hybrid electric vehicles.
- understand the power converters used in hybrid electric vehicles
- know different batteries and other energy storage systems.

Course Content

UNIT–I: Introduction

History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

UNIT–II: Hybridization of Automobile

Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT–III: Plug-in Hybrid Electric Vehicle

PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT–IV: Power Electronics in HEVs

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DCDC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT–V: Battery and Storage Systems

Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource.

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Refernce Books

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction – Dhanpat Rai & Co, 2007.
4. Pistooa G., “Power Sources , Models, Sustanability, Infrastructure and the market”, Elsevier 2008
5. Mi Chris, Masrur A., and Gao D.W., “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 1995.

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Professional Elective - III

ADVANCED DIGITAL CONTROL SYSTEMS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To introduce the theory of z–transformations and its applications for analysis of digital control systems.
- To impart knowledge on the stability of discrete time system using various methods.
- To fimiliraize the basic concepts on the discrete–time systems in state–space model representation.
- To introduce the concepts on design of state feedback controller and observer.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply z–transforms for the mathematical analysis of digital control systems
- determine stability of digital control systems using various test methods.
- apply the concept of controllability and observability to design an appropriate digital feedback controller.
- develop digital hardware controller.

Course Content

UNIT–I: Sampling and Reconstruction

Overview of modern digital control theories, z- and inverse z- transformation and properties, difference Equation – solution by recursion and z-transform, relationship between s- plane and z-plane, sampling theorem – data conversion and quantization mathematical modeling- data reconstruction and filtering of sampled signals – zero- order – hold.

UNIT–II: Stability Analysis

Digital control systems – pulse transfer function of open loop, closed loop systems, stability tests of linear digital control systems, relationship between G(s) and G(z).

UNIT–III: State Space Analysis

State equations of discrete data systems, solution of discrete state equations, state transition matrix Z-transform method. Relation between state equation and transfer functions, Concepts of controllability and observability.

UNIT–IV: State Feedback Controllers and Observers

Digital State observer Design of the full order and reduced order state observer – pole placement design by state feedback, Design of Dead Beat controller – some case studies.

UNIT–V: Digitizing Analog Controllers

Digitizing analog controllers, digital hardware control, and Actuators limitation.

Text Books

1. Discrete-Time Control systems - K. Ogata, PHI/Addison-Wesley Longman Pte. Ltd., India, Delhi, 2nd edition, 1995. (Unit II,III,IV)
2. Digital Control Systems - Kuo, Oxford University Press, 2nd edition, 1992.(Unit I,V)

Reference Books

1. Digital control of dynamic systems – Gene F. Frankin, J.David powell, Michael workman, pearson education, 3rd edition 2000.
2. Digital control and state variable methods – M.Gopal, Tata McGraw Hill, India, 4th edition, 1997.
3. Continuous and Discrete Control Systems – Dorsay, McGraw – Hill, 1996.

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Professional Elective - IV

ADVANCED DIGITAL SIGNAL PROCESSING

II Semester

Lecture	: 3		Internal Marks	:	30
Credits	: 3		External Marks	:	70

Course Objectives

- To understand the various digital filter structures
- To design the FIR and IIR Filters
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform
- To analyze the finite word length effects on various filters
- To learn the concepts of power spectrum estimation of periodic and non-periodic signals

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe structure of digital filters.
- design digital filters with different techniques.
- understand the implementation aspects of signal processing algorithms.
- know the effect of finite word length in signal processing.
- analyze different power spectrum estimation techniques

Course Content

UNIT–I: Digital Filter Structure

Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures.

UNIT–II: Digital Filter Design

Preliminary considerations-Bilinear transformation method of IIR filter designdesign of lowpass, high pass-band pass, and band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on windowed Fourier series- design of FIR digital filters with least –meansquare- error-constrained least-square design of FIR digital filters

UNIT–III: DSP Algorithm Implementation

Computation of the discrete Fourier transform- number representation arithmetic operations handling of overflow-tunable digital filters-function approximation.

UNIT–IV: Analysis of Finite Word Length Effects

The quantization process and errors- quantization of fixed –point and floating -point Numbers-Analysis of coefficient quantization effects, Analysis of arithmetic round-off errors, dynamic range scaling-signal- to- noise ratio in low -order IIR filters-low-sensitivity digital filters- Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters, Round-off errors in FFT Algorithms.

UNIT–V: Power Spectrum Estimation

Estimation of spectra from finite duration observations signals – Nonparametric methods for power spectrum estimation – parametric method for power spectrum estimation, estimation of spectral form-finite duration observation of signals-non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method.

Text Books

1. Digital signal processing-Sanjit K. Mitra-TMH second edition, 2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition-9th reprint

References Books

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis -PHI –3rd edition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold.
4. Digital Filter Analysis and Design-Auntonian-TMH.

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Professional Elective - IV

APPLICATIONS FOR POWER CONVERTERS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the inverters for induction heating applications
- To understand the power converters for different industrial applications
- To understand modeling of high voltage power supplies using the power converters for radar and space applications
- To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computer loads
- To understand the applications of DC-DC converters

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze power electronic application requirements.
- identify suitable power converter from the available configurations.
- develop improved power converters for any stringent application requirements.
- improvise the existing control techniques to suit the application. Design of Bi-directional converters for charge/discharge applications

Course Content

UNIT–I: Inverters for Induction Heating

For induction cooking, induction hardening, melting, and welding applications.

UNIT–II: Power Converters for Lighting, pumping and Refrigeration Systems

Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications.

UNIT–III: High Voltage Power Supplies

Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications.

UNIT–IV: Low voltage High Current Power Supplies

Power converters for modern microprocessor and computer loads.

UNIT – V: Bi-directional DC-DC (BDC) Converters

Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers.

Text Books

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRC Press, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 1st Edition,CRC Press, 2004.

References Books

1. William Ribbens: Understanding Automotive Electronics, Newnes, 2003.
2. Steve Winder Power Supplies for LED Driving, Newnwes, 2008.

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Professional Elective - IV

MICROCONTROLLERS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn about microcontrollers architecture.
- To learn about DSP architecture and assembly programming for DSP processors.
- To learn about basics of FPGA controllers.

Course Outcomes

Upon successful completion of the course, the students will be able to

- design the interfacing circuits for input and output to PIC micro controllers and DSP processors.
- write ALP for DSP processors.
- design PWM controller for power electronic circuits using FPGA.

Course Content

UNIT–I: PIC Microcontrollers

Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC).

UNIT–II: Introduction to DSP

Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core,

Mapping external devices to the C2xx core , peripherals and Peripheral Interface , System configuration registers , Memory , Types of Physical Memory , memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT–III: I/O & Control Registers

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT–IV: ADC & Event Manager

ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV), Event Manager Interrupts , General Purpose (GP) Timers , Compare UNITs, Capture UNITs And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information.

UNIT – V: Introduction to Field Programmable Gate Arrays

CPLD Vs FPGA – Types of FPGA , Xilinx C3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- case study..

Text Books

1. Microcontrollers-Theory and Applications - Ajay V Deshmukh, McGraw Hills, 2005.
2. DSP Based Electro Mechanical Motion Control -Hamid.A.Toliyat and Steven G.Campbell, CRC Press New York, 2004.

Reference Books

1. The 8051 Microcontroller-Kennith J ayala, Thomson publishers,2005.
2. Microprocessor and Microcontrollers by Prof C.R.Sarma.
3. XC 3000 series datasheets (version 3.1). Xilinx,Inc.,USA, 1998.
4. Wayne Wolf," FPGA based system design ", Prentice hall, 2004

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Professional Elective - V

DIGITAL SIGNAL PROCESSOR CONTROLLED DRIVES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To study DSP controllers.
- To learn coding in DSP s to control the electric drive speed.
- To learn speed control methods for induction motor, PMSM, BLDC motors.

Course Outcomes

Upon successful completion of the course, the students will be able to

- interface the DSP platform with sensors such as hall-effect voltage sensors,
- use hall-effect current sensors, shaft encoder for data acquisition for motor drive applications
- scale and normalize the data to suit the requirements of the drive system
- exploit the architectural features of the DSP platform to design and implement
- use algorithms for the realization of controllers, Pulse Width Modulators and observers

Course Content

UNIT–I: Overview of TMS320LF2407 DSP Controller

Review of Instruction Set, Interrupts, normalization and number formatting.

UNIT–II: Clarke's and Park's Transformations

Review ofClarke's and Park's transformations, Implementation of Clarke's and Park's transformation using TMS320LF2407 DSP

UNIT–III: Implementation of PWM Techniques for 3-Ph VSI

Implementation of Sine-triangle and SVPWM withTMS320LF2407 DSP using the concept of imaginary switching time.

UNIT–IV: Control of Induction Motor

Implementation of field oriented control for the speed control of Induction Motor using TMS320LF2407 DSP.

UNIT – V: Control of Special Machines

Principle of operation with drive control system, implementation of control system of BLDC and PMSM using TMS320 LF2407 DSP (Elementary strategy of operation only)

Text Books

1. Hamid A. Toliyat: DSP Based Electromechanical Motion Control, 1st Edition, CRC Press, 2004
2. Ned Mohan, T.M. Undeland and William P. Robbins: Power Electronics: Converters, Applications, 3rd Edition,John Wiley & Sons, 2009.

Reference Books

1. Application Notes from the website of Texas Instruments.

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Professional Elective - V

SMART GRID TECHNOLOGIES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand smart grids and analyze the smart grid policies and developments in smart grids.
- develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- understand smart substations, feeder automation, GIS etc.
- analyze micro grids and distributed generation systems.
- analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Course Content

UNIT–I: Introduction to Smart Grid

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT–II: Smart Grid Technologies: Part 1

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT–III: Smart Grid Technologies: Part 2

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro,Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

UNIT–IV: Micro grids and Distributed Energy Resources

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT–V: Power Quality Management in Smart Grid

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). monitoring and protection.

Text Books

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.

Reference Books

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering & Technology, 30 Jun 2009
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press
6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

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Professional Elective - I

ANALYSIS AND SYNTHESIS OF MECHANISMS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart the concepts of force analysis of mechanisms.
- To familiarize with the concepts of synthesis of mechanisms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the displacement , velocity and accelerations of links of mechanism.
- evaluate the forces and torque acting by performing force analysis.
- apply path curvature characteristics in analysis of mechanisms.
- apply synthesis techniques in design of mechanisms.

Course Content

UNIT – I: Introduction

Elements of mechanisms ,degrees of freedom , Kutchback equation and Grublers criterion , applications of Grublers criterion, transmission angles- extreme values of transmission angles , toggle positions.

Displacement , Velocity and Acceleration Analysis (Analytical methods only): Analysis for four bar and single slider crank mechanisms.

Analysis of Complex mechanisms : Goodman indirect method and Hall Ault auxiliary point method

UNIT – II: Static Force Analysis #

Static Force Analysis #: Static equilibrium , equilibrium of two and three force members , equilibrium of four force members , static force analysis of four bar and slider crank mechanisms.

Dynamic Force Analysis #: D Alembert Principle , dynamic analysis of four bar mechanism and single slider crank mechanism – dynamically equivalent system – inertia of Connecting Rod – inertia force and torque in reciprocating Engine.

UNIT – III: Path Curvature Theory #

Introduction , fixed and moving centrodes , inflection points and inflection circle , Euler Savary Equation , Bobilliers Construction , Collineation axis , Bobillier theorem ,Hartmann construction.

UNIT – IV:

Kinematic Synthesis: Introduction, type, dimensional and number Synthesis , synthesis for function generation, path and motion generation ,Chebyschev Spacing of accuracy points

Graphical Synthesis Techniques: Motion generation for two prescribed positions and three prescribed positions – path generation for three prescribed positions without and with prescribed timing – function generation for three prescribed positions.

UNIT – V: Analytical Synthesis Techniques

Four bar and slider crank function generator with three accuracy points , Freudenstein equation , use of complex numbers and dyads – three prescribed positions for motion, path and function generation using dyad.

Text Books

1. Erdman and Sandor ,"Advanced Mechanism Design ",Prentice Hall International ,2nd Edition
2. S.S. Rattan, " Theory of Machines",Tata Mc Graw Hill, 3rd Edition

Reference Books

1. Uicker, Pennock and Shigley," Theory of machines and Mechanisms", Oxford Univ Press.
2. Amitabha Ghosh and Ashok Kumar Mallik, " Theory of Mechanism and machines", East West Press pvt Ltd,2nd edition.
3. Robert L.Norton," Design of Machinery", Tata McGraw Hill ,3rd edition.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - I

ADVANCED MATERIALS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the advanced materials used in manufacturing and their behaviour under service.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the elastic, yield and fracture behaviour of metals.
- suggest the modern metallic and Non Metallic materials for the applications.
- choose the suitable smart material for manufacturing.
- select the material for the given applications.
- select suitable characterization technique for selection of material.

Course Content

UNIT – I: Fundamentals of Material Science

Elasticity in metals, mechanism of plastic deformation, slip twinning, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening, Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity. Yield criteria: Von mises and Tresca criteria.

UNIT – II: Modern Metallic Materials

Dual phase steels, micro alloyed steels, high strength low alloy (HSLA) Steel, maraging steel, intermetalics, Ni and Ti aluminides, super alloys.

UNIT – III: Non Metallic Materials

Polymeric materials and their molecular structures - production techniques for fibers, foams, adhesives and coatings, structure, properties and applications.

Composites - Introduction, reinforcement, types of composite materials - properties, processing and application of composite materials.

UNIT – IV: Smart Materials

Properties, structure and applications of Smart materials, shape memory alloys, metallic glass, quasi crystal and nano crystalline materials, ceramic materials, cermets, high temperature materials, refractory materials.

UNIT – V: Selection of Materials

Selection criteria - cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue, impact and creep, use of material property charts.

Text Books

1. Mechanical behavior of materials/Thomas H.Courtney/2nd Edition, McGraw-Hill, 2000
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill, 1998
3. Material selction in mechanical design by M.F Ashby. Bott
4. Peter E.J. Flewitt and R.K. Wild, Physical Methods of Materials Characterization, 2nd Edition, Taylor & Francis (2003)

Reference Books

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann. Material science and metallurgy by V.D. Kodgire, Everest publishing house
2. Budinski. G.K. and Budinski. K.M., " Engineering Materials: Properties and Selection", 7th Edition, Prentice Hall of India, 2010.
3. Filnn .R.A. and Trojan .P.K., "Engineering Materials and their Applications", (4th Edition), Jai co, 1999.
4. Metals Hand Book, Vol. 10, "Failure Analysis and Prevention", (10th Edition), 1994.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - I

INDUSTRIAL ROBOTICS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with anatomy, sensors, motion anlaysis, layout design and programming of a industrial robot manipulators.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select appropriate type of sensors and actuators for a robot manipulator.
- analyze kinematics of a robot.
- select suitable end effector and configuration of the machine vision system
- program the robot for a given application.
- design the robot cell for industrial applications.

Course Content

UNIT – I: Introduction

Automation and Robotics, Robot anatomy, robot configuration, motions joint notation scheme, work volume, robot drive systems, control systems and dynamic performance, precision of movement.

Control System and Components: basic concepts and motion controllers, control system analysis, robot actuation and feedback components.

Sensors: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators, power transmission systems.

UNIT – II: Motion Analysis and Control #

Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller, Robot joint control design.

UNIT – III: End Effectors and Machine Vision

End Effectors: Grippers – types, operation, mechanism, force analysis, tools as end effectors, consideration in gripper selection and design.

Machine Vision: Functions, Sensing and Digitizing – imaging devices, Lighting techniques, Analog to digital single conversion, image storage: Image processing and Analysis – image data reduction, Segmentation, feature extraction, Object recognition. Training the vision system, Robotic application.

UNIT – IV:

Robot Programming # : Lead through programming, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching, capabilities and Limitations of lead through methods.

Robot Languages : Textual robot languages, generations of robot programming languages, robot language structure, elements and function.

UNIT – V:

Robot Cell: DESIGN AND CONTROL: Robot cell layouts – Robot centred cell, In – line robot cell, Considerations in work design, Work and control, Inter locks, error detection, work cell controller.

Robot Application: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.

Text Books

1. Industrial Robotics , Groover M P , Pearson Edu.
2. Introduction to Robotic Mechanisms and Control , JJ Craig, Pearson, 3rd Edition.

Reference Books

1. Robotics , Fu K S, McGraw Hill.
2. Robotic Engineering , Richard D Klafter , Prentice Hall.
3. Robot Analysis and Intelligence ,Asada and Slotine , Wiley Inter-Science.
4. Robot Dynamics and Control , Mark W. Spong and M. Vidyasagar , John Wiley.

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Professional Elective - II

GEAR ENGINEERING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the design of gears and different modes of failure.
- To impart the knowledge of gear box design and its optimization.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the types of gear failures.
- design spur and helical gears for the given application .
- design bevel and worm gears for the given application .
- design the gear box for given specifications.
- optimize the parameters of gear like weight, space and cost.

Course Content

UNIT – I: Introduction to Gears

Basic principles, nomenclature, gear manufacturing processes, gear inspection methods. Gear Failure- failure due to bending, pitting, scoring, abrasive, corrosive wear.

UNIT – II: Spur & Helical Gears #

Lewis Method - design of gear teeth - beam strength, Buckingham's dynamic load and wear load.

American Gear Manufacturers Association (AGMA) Method: Plastic deformation using AGMA method - gear design against bending and compressive strength.

UNIT – III: Bevel & Worm Gears #

Lewis Method - design of gear teeth - beam strength, Buckingham's dynamic load and wear load.

American Gear Manufacturers Association (AGMA) Method: Plastic deformation using AGMA method - gear design against bending and compressive strength.

UNIT – IV: Gear Box

Introduction, construction, working principle, ray diagram, kinematic arrangement of gears. design of multi speed gear box.

UNIT – V: Optimal Gear Design

Optimization of gear design parameters, constraints in gear train design- weight and space minimization, cost optimization.

Text Books

1. J.E.Shigley, “Mechanical Engineering Design”, TATA Mc.Graw Hill Education Pvt., Ltd.
2. T.V.Sundarajanmurthy, N.Shanmugam, “Machine Design”, Anuradha Publication, Chennai.

Reference Books

1. V.B.Bandari, “Design of Machine Elements “ TATA Mc.Graw Hill Education Pvt., Ltd..
2. Norton, “Machine Design - An Integrated Approach”, Pearson Publications, 2nd Edition.
3. S. Jalaluddien,” Machine Design” Anuradha Publications, Chennai.

Note: Design data book is allowed for examination.

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Professional Elective - II

ADVANCED OPTIMIZATION TECHNIQUES

I Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the advanced optimization techniques for solving engineering problems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- classify the optimization problems.
- solve the design issues by using techniques of classical optimization.
- apply optimization techniques to design various mechanical elements.
- apply genetic algorithm for solving the design problems.

Course Content

UNIT–I: Introduction

Classification of optimization problems, concepts of design vector, Design constraints, Design space constraints surface, objective function, surface and multilevel optimization, parametric linear programming.

UNIT–II: Classical Optimization Techniques #

Single variable optimization, Multilevel Optimization without constraints – Multilevel Optimization with Equality and inequality constraints – Lagrange multipliers methods Kuhn – Tucker conditions.

UNIT–III:

Non – Linear Optimization #: One – Dimensional Minimization methods – Fibonacci method, Golden section method,

Unconstrained Optimization Methods #: Hooke and Jeeves methods, Powell's method, Gradient of a function, Cauchy method, Fletcher – Reeves method, Types of Penalty methods for handling constraints.

UNIT–IV: Applications of Optimization in Design and Manufacturing Systems#

Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

UNIT–V: Non-Traditional Optimization Techniques

Genetic Algorithm (GA) - Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA, concepts of simulated annealing, ANN, optimization of Fuzzy Systems.

Text Books

1. Optimization for Engineering Design ,Kalyanmoy Deb, 2nd Ediction , PHI Publishers
2. Engineering Optimization , S.S.Rao, 3rd Edition , New Age Publishers

Reference Books

1. Genetic algorithms in Search, Optimization, and Machine learning , D.E. Goldberg, Addison ,13th Edition, Wesley Publishers
2. Multi objective Genetic algorithms , Kalyanmoy Deb,2nd Edition , PHI Publishers
3. Optimal design ,Jasbir Arora, 4th Edition , Mc Graw Hill (international) Publishers.

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Professional Elective - II

ROTOR DYNAMICS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To develop expertise on rotor dynamics and vibration in rotating machinery.
- To expose to rigid rotor dynamics, rotor vibration and critical speeds.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze vibrations in rotating machinery.
- determine the whirling speed of rotor.
- identify the effect of bearings on rotor vibrations.
- analyze balancing and condition monitoring of rotors.

Course Content

UNIT–I: Introduction to Vibration and the Laval-Jeffcott Rotor Model

Co-ordinate systems, steady state rotor motion, elliptical motion, single degree of freedom systems, free and forced vibrations. The two degrees of freedom rotor system, translational motion, natural frequencies and natural modes, steady state response to unbalance, the effect of flexible support.

UNIT–II: Torsional Vibration in Rotating Machinery #

Modeling of rotating machinery shafting - Multi degree of freedom systems - Determination of natural frequencies and mode shapes - Branched systems - Holzer method.

UNIT–III: Rigid Rotor Dynamics and Critical Speeds #

Rigid disk equation - Rigid rotor dynamics- Rigid rotor on flexible rotor - The gyroscopic effect on rotor dynamics - Whirling of an unbalanced simple elastic rotor, simple shafts with several disks - Effect of axial stiffness - Determination of bending critical speeds - Campbell diagram.

UNIT–IV: Influence of Bearing on Rotor Vibration

Support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings.

UNIT–V: Balancing and Condition Monitoring of Rotors

Single plane balancing, multi-plane balancing, balancing of rigid rotors, balancing of flexible rotors Noise spectrum, real time analysis, knowledge based expert systems.

Text Books

1. J. S.Rao, "Rotor Dynamics", New Age International Publishers, New Delhi, 2 nd Edition.
2. S.Timoshenko, D H.Young and W. Weaver , *Vibration Problems in Engineering*, John Wiley, 3rd Edition.

Reference Books

1. Weng Jeng Chen and J Edger Gunter, *Introduction to Dynamics of Rotor – Bearing Systems*, Trafford Publishing Ltd. 3rd Edition.
2. T. Yamamoto and Y.Ishida , *Linear and Nonlinear Rotordynamics: A Modern Treatment with Applications*, John Wiley and Sons Inc, 2nd Edition.
3. J. S.Rao, *Vibratory Condition Monitoring of Machines,* Narosa Pubulishing House, 2nd Edition.

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Professional Elective - III

DESIGN FOR MANUFACTURING AND ASSEMBLY

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the design factors used in manufacturing and assembly.

Course Outcomes

Upon successful completion of the course, the students will be able to

- incorporate the process constraints & other influencing factors for design.
- design a metal casting product considering troubleshooting elements.
- design a defect free weldment.
- select appropriate material and manufacturing process for product development.
- suggest an assembly for ease of manufacture and automation.

Course Content

UNIT – I: Design for Manufacturing

Reduce the cost of manufacturing process, understanding the process and constraints, standard components and process, impact of DFM on industry with case studies.

UNIT – II: Design Consideration in Metal Casting

Overview of various casting**s,** Mold and gating system design of a sand casting with design considerations, directional solidification, and troubleshooting.

UNIT – III: Design Considerations for Welding, Forging, Sheet Metal and Powder Metal Process

Overview of joining and forming operations, Design guidelines for joining and forming operations, Keeler Goodman forming limit diagram, defects, concept of residual stresses.

UNIT – IV: Design Considerations in Machining

Overview of various machining processes, design rules and recommendations for various machining and machined parts.

UNIT – V: Design for Assembly and Automation

Application of design for manufacture and assembly with selection of materials and ranking of processes like casting, injection moulding, sheet metal working, die casting, powder metal process, investment casting and hot forging. Design for assembly guidelines and automation.

Text Books

1. George E. Dieter, “Engineering Design – A Material Processing Approach”, McGraw Hill International, 2nd Edition

Reference Books

1. Geofrey Boothroyd, Peter Dewhurst, “Product Design for Manufacture and Assembly”, CRC Press, 3rd Edition.
2. O. Molloy, “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”, Chapman and Hall, 1st Edition.

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Professional Elective - III

MECHATRONICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart knowledge on design of complex engineering systems using sensors, actuators, controllers.
- To familiarize with the intelligent systems used in Mechatronics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the elements of Mechatronics System
- design mechatronics control application using Hydraulics, Pneumatics and electrical applications.
- select suitable sensors, actuators and controllers to meet specific requirements
- understand the concepts of intelligent systems and its application in control of mechatronics systems
- understand the concepts of intelligent systems and its application in control of mechatronics systems

Course Content

UNIT–I: Mechatronics Systems

Elements & levels of mechatronics system, Mechatronics design process, measurement systems, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT–II: Hydraulic and Pneumatic Actuating Systems

Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements, Circuit Diagrams – Hydraulics and Pneumatics.

UNIT–III: Digital Electronics and Systems

Digital logic control, micro processors and micro controllers, process controllers, programmable logic controllers, PLCs versus computers, Basic programming and input-output devices interfacing with micro-controllers and programmable logic controllers, ladder programming. Design and modeling of computer controlled electro-mechanical systems.

UNIT–IV: System Interfacing and Data Acquisition

Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, interfacing motor drives.

UNIT–V: Intelligent Systems

Fuzzy Logic – Basics of fuzzy, Sets, Membership function, Fuzzification & defuzzification. Artificial neural network – Nomenclature of ANN, back propagation algorithm, supervised and unsupervised learning, Artificial Intelligence. Design of mechatronics systems & future trends. Case Studies - Mechatronics in Automobiles, prosthetics and artificial limbs, Machine Control etc.

Text Books

1. Bolton. W, "Mechatronics", 4th Edition, Addison Wesley, New Delhi.
2. Devadas Shetty, Richard A Kolk, "Mechatronics System Design", 2nd edition, Cengage Learning.
3. Michael B.Histand and David G.Aliatore, "Introduction to Mechatronics and Measurement Systems" Special Indian 3rd edition, McGraw-Hill.

Refernce Books

1. Dan Nesulescu, "Mechatronics", 3rd Edition, Pearson Education.
2. N. Sivanandam and S.N.Deepa, "Principles of Soft Computing", 2nd edition, Wiley India Pvt.Ltd.
3. B.P.Singh and Renu Singh, "Advanced Microprocessor and Microcontrollers" 3rd edition, New Age International Publisher.
4. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd edition, Pearson Education.
5. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and application", 2nd edition, PHI.

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Professional Elective - III

VEHICLE DYNAMICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of vehicle dynamics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop different approaches for modeling of vehicles for dynamic analysis
- analyse pneumatic tyres by considering forces and moments
- determine the characteristics of vehicles and vehicle ride.

Course Content

UNIT–I: Introduction to Vehicle Dynamics

Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.

UNIT–II: Mechanics of Pneumatic Tyres

Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.

UNIT–III: Performance Characteristics of Road Vehicle

Equation of motion and maximum tractive effort, Aerodynamic forces and moments, Vehicle power plant and transmission characteristics, Prediction of vehicle performance, Operating fuel economy, Braking performance.

UNIT–IV: Handling and Stability Characteristics of Road Vehicles

Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.

UNIT–V: Vehicle Ride Characteristics

Human response to vibration, Vehicle ride models, Introduction to random vibration - 1) Road suirface profile as a random function, 2) Frequency response function, 3) Evaluation of vehicle vertical vibration in relation to ride comfort criteria, 4) Active and semi active systems, 5) Optimum design for ride comfort and road holding.

Text Books

1. Wong , "Theory of Ground Vehicles", John Wiley and Sons, NY,4th edition, 1993.

Reference Books

1. Gillespie, T.D. "Fundamentals of Vehicle Dynamics", SAE Publication, Warrendal, USA, 1992.
2. Dixon, J.C., "Tyres, Suspension and Handling",SAE Publication, Warrendal, USA and Arnold Publication, London, 1997.

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Professional Elective - IV

SIGNAL ANALYSIS AND CONDITION MONITORING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of maintenance and condition monitoring methods.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply maintenance strategies for plant maintenance to reduce the cost.
- analyze the machine condition with the aid of measuring instruments and signal analysis.
- select appropriate test for fault identification for a given application.
- carry out lubrication oil analysis and temperature analysis for given applications.
- analyze the case study including the fault identification and root causes of malfunction.

Course Content

UNIT–I: Maintenance

Maintenance history, Maintenance strategies, influence of maintenance on cost of the product, role of maintenance in condition monitoring, applications of condition monitoring in various sectors.

UNIT–II: Vibration Monitoring and Flaw Detection Methods

Vibration Monitoring: Rotating machinery - machine faults, root causes, trouble shootings of machine faults, vibration analysis - ISO Standards, types and benefits.

Flaw Detection Methods: classification of Flaws, fault detection methods in NDT- Liquid Penetration Technique, ultrasonic testing and magnetic particle inspection, Eddy current Testing.

UNIT–III: Signal Analysis & Vibration Measuring Instruments

Signal Analysis: Introduction, basic concepts, Fourier analysis, Bandwidth, Signal types, Convolution, Signal analysis - Filter response time, Detectors, Recorders, Analog analyzer types.

Vibration Measuring Instruments: Vibration transducers – displacement, velocity and acceleration. Laser vibrometer. accelerometers – piezo resistive, capacitive and inductive type. FFT analyzer - working principle, vibration signature analysis.

UNIT–IV: Wear Debris Analysis and Temperature Monitoring

Wear Debris Analysis: Wear mechanisms, types of wear, wear particles analysis - Ferrography, spectrometric oil analysis program (SOAP).

Temperature Monitoring: Need for temperature monitoring, principle of thermography, types - active and passive thermography, IR thermography.

UNIT–V: Case Studies

Gear box, induction motor, transformer, roller bearings, wind mill, Induced Draught and Forced Draught fans.

Text Books

1. R.A. Collacote, "Mechanical Fault diagnosis and Condition Monitoring", Springer publications.

References Books

1. R.B.Randall , "Frequency Analysis" , Bruel & KJaer publications
2. V. Ramamurti," Mechanical Vibrations Practice with Basic Theory" , Narosa Publishing House.

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Professional Elective - IV

FRACTURE MECHANICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the basic concepts of fracture mechanics and its applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- elaborate different mechanisms of fracture failure.
- determine stress intensity factors by applying Linear Elastic and Elastic Plastic fracture mechanics.
- evaluate stresses induced at crack tip and different fracture parameters.
- apply different approaches to determine the plastic zone at the crack tip.
- select suitable nondestructive test to identify the cracks.

Course Content

UNIT–I:

Introduction: History and over view, fracture mechanics approach to design, effect of material properties on fracture.

Fracture Mechanisms: Ductile fracture, cleavage, ductile-brittle transition, inter granular fracture, environment assisted cracking.

Linear Elastic Fracture Mechanics : Griffith energy balance , energy release rate , crack resistance , R curve , stable and unstable crack growth.

UNIT–II:

Stress Analysis of Cracks#: Modes of fracture - opening , sliding and shearing mode , Airy stress function , crack tip stress field using Westergaurd approach, effect of finite size , relation between stress intensity factor and energy release rate.

UNIT–III:

Crack Tip Plastic Zone#: Plastic zone shape , Irwin plastic zone correction, Dugdale approach, shape of the plastic zone, plastic constraint factor, thickness effect.

UNIT–IV:

Elastic-Plastic Fracture Mechanics: Crack-tip-opening displacement, J contour integral, relationships between J and CTOD, crack-growth resistance curves, J-controlled fracture.

UNIT – V:

Test Methods: Introduction, K_{Ic}-test technique, test methods to determine J_{Ic}, test methods to determine G_{Ic} AND G_{IIc}, determination of critical CTOD.

Crack Detection Through Non-Destructive Testing: Introduction, examination through human senses, liquid penetration inspection, ultrasonic testing, radiographic imaging, magnetic particle inspection.

Text Books

1. T. L. Anderson, Fracture Mechanics: Fundamentals and Applications, CRC Press, 3rd edition
2. Prashant Kumar, Elements Of "Fracture Mechanics, Mcgraw Hill Education,First edition.

References Books

1. David Broek, Elementary engineering fracture mechanics, Kluwer Academic Publishers, 4th edition
2. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths, 1973.
3. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials, 2nd Edition.

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Professional Elective - IV

EXPERIMENTAL STRESS ANALYSIS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of experimental methods to determine stresses and strains

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the three dimensional stresses and interpret with different loading conditions
- measure strains using different types of strain gauges and also identify different frequency recording systems
- identify and evaluate stresses using modern optical techniques of experimental methods
- identify and evaluate stresses and strains developed in coating materials
- determine and distinguish effecting parameters in the fringe formation of birefringent coating materials.

Course Content

UNIT–I:

Introduction: stress, strain, plane stress and plane strain conditions, compatibility conditions. problems using plane stress and plane strain conditions, stress functions, Mohr's circle for stress strain, three- dimensional stress strain relations.

UNIT–II:

Strain Measurement and Recordings: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauges, strain gauge circuits. static recording and data logging systems, dynamic recording at very low, intermediate, high and very high frequencies.

UNIT–III:

Photo elasticity: photo elasticity – Polariscope – plane and circularly polarized light –isochromatic fringes – isoclinics fringe formation.

Three dimensional Photo elasticity#: locking in model deformation, three dimensional photo elastic materials, slicing three-dimensional models and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions.

UNIT–IV:

Brittle coatings: Introduction, coating stresses, brittle coating crack patterns, crack detection, ceramic and resin brittle coatings, testing and calibration procedures for brittle coatings analysis.

Moire Methods#: Introduction, mechanism of formation of Moire fringes, the geometrical and displacement approach to moire-fringe analysis. Out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-fringes, experimental procedure and techniques.

UNIT – V:

Birefringent Coatings: Introduction, coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, fringe order determinations in coatings, stress separation methods.

Text Books

1. Timoshenke and Goodier Jr ,"Theory of Elasticity", 3rd edition, McGraw Hill Education (India) Pvt Ltd.

Reference Books

1. Love .A.H, "A treatise on Mathematical theory of Elasticity vol-1" Nabu Publishers.
2. Sadhu Singh," Experimental stress analysis", Khanna Publishers.
3. Dally and Riley," Experimental stress analysis", Mc Graw-Hill.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - V

TIBOLOGY

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the selection of lubricating system for different machine components
- To impart knowledge on design of bearings for a given application.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select the appropriate bearing lubricant for given application.
- select the rolling element bearing for the given conditions.
- design hydrostatic, hydrodynamic and air lubrication systems used in bearings.
- select a suitable seal for a given application.
- analyze the condition of bearing with the aid of instruments to avoid machine failure.

Course Content

UNIT–I:

Surfaces and Friction: Topography of engineering surfaces- Contact between surfaces, friction and wear mechanisms.

Lubrication: Choice of lubricants, types of oil, grease and solid lubricants-additives- lubrication systems and their selection.

UNIT–II:

Selection of Rolling Element Bearings#: Nominal life, Selection of Bearing-type -Static and Dynamic Capacity-Equivalent Load, Bearing with Probability of Survival other than ninety percent - Cubic mean load -Pre-loading of bearings.

UNIT–III:

Hydrostatic Bearings#: Introduction to hydrostatic lubrication- Viscous Flow through Rectangular Slot, thrust bearings – Hydrostatic Circular Step Bearing - Load carrying capacity and energy losses and optimum design and Oil-film thickness. Aerostatic Bearing lubrication: Introduction, merits and demerits, applications, externally pressurized gas bearings.

UNIT–IV:

Hydrodynamic bearings#: Principles of hydrodynamic lubrication–mechanism of pressure development in the oil-film, Lubrication Regimes-Reynolds's equation for two-dimensional flow; hydrodynamic journal bearings-Analysis of infinitely long and infinitely short bearings- Raimondi and Boyd solution-Sommerfeld Number-Performance Parameters– friction-heat generated and heat dissipated. Hydrodynamic thrust bearings- Analysis of plane slider bearing with fixed and tilting pads.

UNIT – V:

Seals: Different type-mechanical seals-essential properties of the seals, lip-ring seals, soft piston seals, Mechanical piston rod packing, labyrinth seal- packed glands- mechanical contact seals- selection of mechanical seals. Gaskets- oil flinger rings and drain grooves.

Failure of Tribological Components: Failure analysis of plain bearings, rolling bearings, gears and seals-

Vibration based condition monitoring: Vibration data collection; techniques; instruments; transducers; commonly bearing faults diagnosed by vibration analysis, shock pulse method.

Text Books

1. Rowe WW& O' Dionoghue, "Hydrostatic and Hybrid bearing design", Butterworths & Co. Publishers Ltd, 1st edition,1983,(UNITS-I,III,IV,V)
2. Collacott R.A, "Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London ,1st edition,1977.(UNITS-I,II)

Reference Books

1. Shigley J, E Charles, " Mechanical Engineering Design", McGraw Hill Co.,6th Edition.
2. Bernard J. Hamrock, "Fundamentals of fluid film lubricant", McGraw-Hill Co.,1st edition, 1994.(UNITS-I,II,III)
3. Neale MJ, (Editor) "Tribology hand Book" ,Neumann Butterworths,1975.
4. Connor and Boyd JJO (Editors) "Standard hand book of lubrication engineers" ASLE, McGraw Hill Book & Co.,1968.

Note: Design data book is allowed for examination

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - V

COMPOSITE MATERIALS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of composite materials, fabrication techniques and their properties.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the fundamental concepts of composite materials.
- select a suitable technique for fabrication of composite material.
- determine the various properties of composite materials.
- choose a suitable technique to evaluate micro structural properties.

Course Content

UNIT–I:

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Carbon, boron, silicon carbide, and born carbide, Fibres- Glass, Silica, Kevlar, Natural fibres (cellulose, jute, coir etc).

UNIT–II:

Liquid State Fabrication Techniques: Stir Casting, Infiltration, Gas Pressure Infiltration, Squeeze Casting Infiltration, Pressure Die Infiltration, nano composites,

Manufacturing of Laminated composite plates:

Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT–III:

Solid State Fabrication Techniques: Powder Metallurgy, Hot Isostatic Pressing, Hot Forging (Powder Forging), Metal Injection Moulding (MIM), Diffusion Bonding, Vapour Deposition, Physical Vapour Deposition.

Solid State Fabrication Techniques: Friction Stir Welding – fabrication method – change of translational speed and rotational speed – nature of cooling system.

UNIT–IV:

Properties of composites: Rule of mixtures, ASTM standard specimens, determination of physical properties - density, mechanical properties –Tensile, compression, micro hardness, impact strength, wear properties and corrosion properties.

UNIT–V:

Microstructure Properties – Grain size, Micro Structure - X-ray diffraction (XRD), Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Electron microprobe analysis (EDAX).

Text Books

1. Krishan K. Chawla, “Composite Materials, Science and Engineering”, Springer, 3rd Edition.
2. Suresh G. Advani, E. Murat Sozer, “Process Modelling in Composites Manufacturing”, 2nd Ed. CRC Press, 2009.

Reference Books

1. Lawrence E. Nielsen, Nielson, Paul Nielsen, Mechanical Properties of Polymers and Composites, Second Edition, CRC press, 2000.
2. Steven L. Donaldson, “ASM Handbook Composites”, Material Park, Ohio : ASM International, ©2001, [ie 10th ed.].

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - I

TESTING AND TESTABILITY OF VLSI CIRCUITS

I Semester

Lecture	: 3		Internal Marks	:	30
Credits	: 3		External Marks	:	70

Course Objectives

- To familiarize with the basics of testing techniques.

Course Outcomes

Upon successful completion of the course, the students will be able to

- interpret the concepts of modeling digital circuits
- apply the concepts in testing and verification of a digital design
- identify the design for testability methods for combinational & sequential circuits.
- recognize the BIST techniques for improving testability.

Course Content

UNIT – I: Introduction to Fault Modeling

Modeling Digital circuits at logic level, register level and structural level, levels of modeling, Difference between testing, fault diagnosis and verification. Physical faults and their modeling: stuck-at faults, bridging faults, CMOS stuck-open and stuck-on faults. Fault collapsing: fault equivalence and fault dominance.

UNIT – II: Logic and Fault Simulation

Logic simulation techniques: compiled code, event-driven simulation. Fault simulation techniques: parallel, deductive and concurrent fault simulation, critical path testing. Fault models, fault detection and redundancy, fault equivalence and fault location, fault dominance, automatic test pattern generation.

UNIT – III: Test automation and Design verification

Deterministic test generation for combinational circuits: Exhaustive and pseudo-exhaustive test pattern generation, Pseudo-random test pattern generation, Linear feedback shift register (LFSR), characteristic polynomial, Weighted random pattern generation, Test generation for sequential circuits: time frame expansion method, domain.

UNIT – IV: Design for Testability (DFT)

Test pattern generation for sequential circuits: Scan architectures and testing-controllability and observability, generic boundary scan, fully integrated scan, adhoc and structured techniques. Scan path and level sensitive scan design (LSSD). Boundary scan (JTAG) standard.

UNIT – V: Built-in Self-test (BIST)

BIST concepts and test pattern, BIST for testing of logic and memories, Test automation, Specific BIST architectures: BILBO, STUMPS, CSBL, BEST, RTs, LOCST. Introduction to advanced BIST concepts, design for self test at board level.

Text Books

1. M. Abramovici, M. A. Breuer and A. D. Friedman, “Digital Systems Testing and Testable Design”, Jaico Publishing House, 1990. (Units I-V)

Reference Books

1. N. N. Biswas, “Logic Design Theory”, PHI, 2001.
2. Z. Kohavi, “Switching and Finite Automata Theory”, TMH, 2nd Edition, 2001.

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Professional Elective - I

ADVANCED DIGITAL DESIGN

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the Synthesis of Combinational and Sequential logic circuits.
- To introduce the techniques and tools for programmable logic design.
- To acquaint with the knowledge of fault diagnosis in combinational and sequential circuits.

Course Outcomes

Upon successful completion of the course, the students will be able to

- synthesize Combinational and Sequential logic circuits
- design and Synthesize the Datapath Controllers..
- program the PLDs..
- model the architectures for Arithmetic Proceesors
- design the state machines using SM charts.

Course Content

UNIT – I: Synthesis of Combinational and Sequential logic

Review of Combinational and Sequential logic design ,Introduction to synthesis ,Synthesis of combinational logic, Synthesis of sequential logic with latches, Synthesis of three state devices and bus interfaces, Synthesis of sequential logic with flipflops, Registered logic, State encoding, Synthesis of gated clocks and clock enables, Anticipating the results of synthesis.

UNIT – II: Design and Synthesis of Datapath Controllers

Partitioned sequential machines, Design example: Binary counter , Design and synthesis of a RISC stored-program machine ,Processor, ALU, Controller, Instruction Set, Controller Design and Program Execution.

UNIT – III: Programmable Logic Devices

Programmability of PLDs, Complex PLDs, Xilinx Virtex FPGA's, Verilog based Design flows for FPGA's, Synthesis with FPGA's, Xilinx Kintex 7 FPGA features, ZynQ SoC features.

UNIT – IV: Architectures for Arithmetic Processors

Review of functional units for addition and subtraction, Functional units for multi-plication - combinational binary multiplier, sequential binary multiplier, sequential Multiplier design: Hierarchical decomposition, efficient STG based Sequential binary Multiplier, Booth's-Algorithm Sequential Multiplier, Multiplication of signed Binary numbers, Multiplication of fractions.

UNIT – V: State Machine Design with SM charts

State Machine charts, Derivation of SM charts, Realization of SM charts, Fundamental state Model-Flow Table-State Reduction-Minimal Close d covers, Races, cycles, Hazards.

Text Books

1. Michael D. Ciletti, "Advanced Digital Design with the VERILOG HDL, 2nd Edition, Pearson Education, 2010. (Units: I, II, III, IV).
2. Charles H.Roth, "Fundamentals of Logic Design", TMH, 7th Edition. (Unit: V)

Reference Books

1. Stephenbrown, "Fundamentals of Digital Logic with Verilog", McGraw-Hill-2007
2. Samuel C. Lee, "Digital Circuits and Logic Design", PHI, 1st Edition.
3. https://www.xilinx.com/products/silicon-devices/fpga/kintex-7.html (Unit: III)
4. https://www.xilinx.com/support/documentation/data_sheets/ds190-Zynq-7000-Overview.pdf (Unit: III)

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Professional Elective - I

DIGITAL SIGNAL AND IMAGE PROCESSING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To introduce the concepts of Z-transform and frequency domain representation of discrete time signals and to familiarize with the designing of digital filters and finite word length effects.
- To introduce fundamental concepts of image processing and different operations on image elements. and expose to the practical problems associated with processing of an image.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select appropriate type of sensors and actuators for a robot manipulator.
- analyze discrete-time signals and systems in various domains (i.e Time, Z and Fourier)
- design the digital filters (both IIR and FIR) from the given specifications
- analyze the quantization effects in digital filters and understand the basics of image sampling, quantization and image transforms.
- understand the concepts of image enhancement, image restoration and image segmentation.
- know the various methods involved in image compression and fundamentals in color image processing.

Course Content

UNIT – I:

Review of Discrete Time signals and systems, Characterization in time, Z and Fourier domain, Fast Fourier Transform using Decimation In Time (DIT) and Decimation In Frequency (DIF) Algorithms.

UNIT – II:

IIR Digital Filters: Introduction, Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters using Impulse Invariance, Bilinear Transformation methods.

FIR Digital Filters: Introduction, Design of FIR Digital Filters using Window Techniques, Frequency Sampling technique, Comparison of IIR & FIR filters

UNIT – III:

Analysis of Finite Word length Effects: The Quantization Process and Errors, Quantization of FixedPoint Numbers, Quantization of Floating-Point Numbers, Analysis of Coefficient Quantization effects.

Introduction to Digital Image Processing: Introduction, components in image processing system, Applications of Digital image processing, Image sensing and acquisition, Image sampling, Quantization, Basic Relationships between pixels, Image Transforms: 2D-DFT, DCT, Haar Transform.

UNIT – IV:

Image Enhancement: Intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, the basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.

Image Restoration: Introduction, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.

Image Segmentation: Fundamentals, point, line, edge detection, thresholding, region based segmentation.

UNIT – V:

Image Compression: Fundamentals, Basic compression methods: Huffman coding, Arithmetic coding, Run-Length coding, Block Transform coding, Predictive coding, Wavelet coding.

Color Image Processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

Text Books

1. John G. Proakis, Dimitris G.Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", PearsonEducation/PHI,2007.
2. S. K. Mitra. "Digital Signal Processing – A Computer based Approach", TMH, 3rd Edition, 2006
3. Rafael C.Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education, 2011.
4. S.Jayaraman, S.Esakkirajan, T.Veerakumar, "Digital Image Processing", Mc Graw Hill Publishers, 2009.

Reference Books

1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006 2. Digital Signal Processing: MH Hayes, Schaum s Outlines, TATA Mc-Graw Hill, 2007.
2. Anil K. Jain, "Fundamentals of Digital Image Processing," Prentice Hall of India, 2012.

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Professional Elective - II

VLSI SIGNAL PROCESSING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the basic concepts of DSP algorithms.
- To Introduce the various pipelining and parallel processing techniques.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply DSP algorithms on to the IC technology
- realize the concept of Retiming, unfolding in VLSI based DSP
- analyze the concept of pipelining and processing for DSP
- optimize the Delay using Folding.

Course Content

UNIT – I:

Introduction: A Digital Signal- Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation, Q-Notation.

UNIT – II:

Basic FIR filter, architectures, Simple Block diagrams and Signal flow graphs, Dataflow Graphs, Iteration Period, FIR filter iteration period, IIR filter iteration period, Computation Model, Constraint analysis for IPB computation, Motivational examples for IPB, General IPB computation.

UNIT – III:

Parallel architecture, Odd-even register reuse, Power consumption, Pipelining, Pipelining FIR filter, Time-invariant systems, Valid pipelining examples, Balanced pipeline, Retiming theorem and concept, Retiming IIR filter, ASAP schedule, Utilization Efficiency, Iteration period bound and scheduling.

UNIT – IV:

Pipelining and parallel processing, pipelining of FIR Digital Filters, Pipelining and parallel processing for low power. Systolic architecture design: systolic array design Methodology.

UNIT – V:

Folding of DFG, Folding Examples - IIR Filter, Retiming for folding, Introduction to Delay Optimization by Folding, Parallel implementation of FIR filters, Unfolding Transformation, Look ahead Transformation.

Text Books

1. Keshab K.Parhi Design and Implementation", "VLSI Digital Signal Processing systems", Wiley, Inter Science, 1999. (ISBN Number: 0-471-24186-5).
2. Avatar Singh and S. Srinivasan, "Digital Signal Processing", Thomson Learning, 2004.

Reference Books

1. S.Y. Kung, H.J. White House, T.Kailath, "VLSI and Modern Signal Processing", Prentice Hall, 1985.
2. John G.Proakis, Dimitris G.Manolakis "Digital Signal Processing", Prentice Hall of India, 1995.

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Professional Elective - II

SYSTEM DESIGN WITH EMBEDDED LINUX

I Semester

Lecture	: 3		Internal Marks	:	30
Credits	: 3		External Marks	:	70

Course Objectives

- To familiarize with embedded Linux development model.
- To develop various embedded drivers such as the Serial driverand USB gadgets.

Course Outcomes

Upon successful completion of the course, the students will be able to

- familiarize with embedded Linux development model.
- developsimpleembedded Linux drivers.
- develop basic Board Support Packages.
- familiarize with porting, building and debugging applications.

Course Content

UNIT–I: Introduction to Embedded Linux

Embedded Linux , Vendor Independence, Time to Market,Varied Hardware Support, Open Source,Standards (POSIX®) Compliance, Embedded Linux Versus Desktop Linux, Embedded LinuxDistributions, BlueCat Linux, Cadenux , Denx, Embedded Debian (Emdebian),ELinOS (SYSGO),Metrowerks ,MontaVista Linux, RTLinuxPro, TimeSys Linux, Basic commands.

UNIT–II: Overview

Embedded Linux Architecture, Real-Time Executive, Monolithic Kernels, Microkernel-Kernel Architecture – HAL, Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC,User space, Start-up sequence, Boot Loader Phase, Kernel Start-Up, User Space Initialization.

UNIT–III: Board Support Package and Embedded Storage

Board Support Package definition, Embedded Storage: Flash Map, MTD Architecture-NAND vs NOR, Embedded File Systems,Optimizing Storage Space,Tuning Kernel Memory.

UNIT–IV: Embedded Drivers

Overview: Serial,USB, watchdog Timer, Kernel Modules.

UNIT–V: Application Porting,Building and Debugging

Porting Applications, Architectural Comparison, Application Porting Roadmap, Programmingwith Pthreads (only function names), OSPL definition, Building and Debugging in Linux (only overview).

Text Books

1. P Raghvan, Amol Lad, SriramNeelakandan, “Embedded Linux System Design and Development”, Auerbach Publications.

Reference Books

1. KarimYaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, “Building Embedded Linux Systems” O’Reilly publications, 2nd edition.
2. Christopher Hallinan, “Embedded Linux Primer: A Practical Real World Approach”, Prentice Hall, 2nd Edition, 2010.
3. Derek Molloy, “Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux”, Wiley, 1st Edition, 2014.

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Professional Elective - II

PARALLEL PROCESSING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with Implementation of pipelining and pipelining techniques.
- To develop parallel programming techniques.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify limitations of different architectures of computer
- analyze quantitatively the performance parameters for different architectures
- investigate the issues related to parallel programming development.

Course Content

UNIT–I: Overview

Over view of Parallel Processing and Pipelining, Performance metrics and measures, Scalability metrics, research issues and solutions.

UNIT–II: Advanced Processor Technology

Design space of processors, Instruction set architectures,CISC and RISC scalar processors, VLIW architecture, super scalar, vector and symbolic processors.

UNIT–III: Pipelining Techniques

Linear pipeline processors: Asynchronous and synchronous models, clocking and timing control, speedup efficiency, and throughput. Non linear pipeline processors: reservation and Latency analysis, collision free scheduling, pipeline schedule optimization.

UNIT–IV: Multithreading

Latency hiding techniques, Principles of multithreading, Issues and solutions, Multi dimensional architectures, Multicontext processors.

UNIT–V: Parallel Program Development

Message passing program development, Synchronous and asynchronous message passing.

Domain Decomposition, Control decomposition techniques, Heterogeneous processing.

Text Books

1. KaiHwang, Nareshjotwani, “Computer Architecture Parallelism, scalability, programmability”, MGH second edition. (Unit I – Unit V).
2. V. Rajaraman, L. Sivaram Murthy, “Parallel Computers”, PHI.

Reference Books

1. William Stallings, “Computer Organization and Architecture, Designing for performance “Prentice Hall, Sixth edition.
2. Kai Hwang, Faye A. Briggs, “Computer Architecture and Parallel Processing”, MGH International Edition.
3. David Harris and Sarah Harris, “Digital Design and Computer Architecture”, Morgan Publishers.

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Professional Elective - III

ADVANCES IN VLSI DESIGN

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the current IC technologies, SOI MOSFETs, memristors, memories, reversible and adiabatic logic circuits.
- To acquaint with the power reduction, testing, yield, and packaging techniques, and verify the robustness of nanometer CMOS designs.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the basic operation of CCD and CMOS image sensors, BICMOS circuits, power MOSFETs, SOI MOSFETs, memristors, reversible and adiabatic logic circuits.
- model multi-gate FETs
- distinguish working of various types of memories
- analyze power reduction, testing, yield, packaging techniques
- verify clocking, critical timing, signal integrity, variability, and reliability of nanometer scale CMOS circuit designs.

Course Content

UNIT – I: Special Circuits, Devices and Technologies

CCD and CMOS image sensors, BICMOS circuits, power MOSFETs, bipolar-CMOS-DMOS(BCD) processes, SOI MOSFET-MOSFET scaling and Moore's law, short-channel effects, gate geometry and electrostatic integrity, brief history of multiple-gate MOSFETs, framework for multi-gate FET modeling, multi-gate BSIM-CMG and BSIM-IMG models; Memristors-introduction, working of memristance, resistance to memristance, axiomatic definition of circuit elements.

UNIT – II: Memories

Introduction, serial memories, content-addressable memories, random-access memories, non-volatile memories, embedded memories.

UNIT – III: Power Reduction Techniques, Testing, Yield, and Packaging

Battery technology, sources of power consumption, technology options for low power, design options for power reduction, testing, yield, packaging.

UNIT – IV: Robustness of Nanometer CMOS Designs

Clock generation, clock distribution and critical timing, signal integrity, variability, reliability.

UNIT – V: Fundamentals of Reversible and Adiabatic Logic Circuits

Fundamental concepts of reversible logic, a brief history of reversible computation and adiabatic logic, fundamentals of adiabatic logic - the charging process in adiabatic logic compared to static CMOS, an adiabatic system, loss mechanisms in adiabatic logic, voltage scaling, properties of adiabatic logic and resultant design considerations.

Text Books

1. Harry J.M. Veendrick, "Nanometer CMOS ICs: From Basics to ASICs", Springer International Publishing, AG 2017, Second Edition (Units: I – IV).
2. Jean-Pierre Colinge (Ed.), "FinFETs and Other Multi-Gate Transistors", Springer Series on Integrated Circuits and Systems, 2008 (Unit: I).
3. Ronald Tetzlaff (Ed.), "Memristors and Memristive Systems", Springer Science, 2014 (Unit: I).
4. Ashutosh Kumar Singh, Masahiro Fujita, and Anand Mohan (Eds.), "Design and Testing of Reversible Logic", Springer Lecture Notes in Electrical Engineering, Volume 577, 2020 (Unit: V).
5. Philip Teichmann, "Adiabatic Logic: Future Trend and System Level Perspective", Springer Series in Advanced Microelectronics, 2012 (Unit: V).

Reference Books

1. Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic, "Digital Integrated Circuits-A Design Perspective", Prentice Hall Inc., 2nd Edition, 2003.
2. Neil H.E.Weste and David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective, Addison-Wesley, 4th Edition, 2011.
3. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", McGraw-Hill International 3rd Edition, 2003.

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Professional Elective - III

EMBEDDED COMPUTER ARCHITECUTERS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with embedded platform, processor architectures and power optimization techniques.
- To impart the knowledge of VLIW and ISA Architectures.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand embedded platform and processor architectures.
- make intelligent choices between hardware/software tradeoffs.
- analyze different power optimization techniques in processor architectures.
- develop an embedded system with VLIW, ISA Architectures.
- understand embedded processing in automotive and Hard disk drives Applications.

Course Content

UNIT–I: Embedded Platform Architecture

Embedded platform overview and characteristics, volatile memory technologies, non- volatile storage, device interface-high performance, universal serial bus, device interconnect – low performance; general purpose input/output, power delivery.

UNIT–II: Embedded processor Architecture

Basic execution environment, application binary interface, processor instruction classes, exceptions/interrupts model, vector table structure, exception frame, masking and acknowledging interrupts, interrupt latency, memory mapping and protection, MMU and processes, memory hierarchy, Intel atom micro architecture.

UNIT–III: Power Optimization

Basics, power profile of an embedded computing system, constant versus dynamic power, simple model of power efficiency, advanced configuration and power interface, optimizing software for power performance.

UNIT–IV: Overview of VLIW and ISA

Semantics and Parallelism, Design Philosophies, VLIW in the Embedded and DSP Domains, Basic VLIW Design Principles, Designing a VLIW ISA for Embedded Systems.

UNIT–V: Application Areas

Automotive- Fail-safety and Fault Tolerance, Engine Control Units, Hard disk drives- Motor Control, Data Decoding, Disk Scheduling and on/off -disk Management.

Text Books

1. Peter Barry and Patrick Crowley, “Modern Embedded Computing”, 1st Edition, Elsevier/Morgan Kaufmann, 2012.(Units I to III).
2. Joseph A.Fisher, Paolo Faraboschi, Cliff Young, “Embedded computing: a VLIW approach to architecture, compilers and tools”, Elsevier/ MorganKaufmann, 2005. (Units IV and V).

Refernce Books

1. DezsoSima, Terence Fountain, Peter Kacsuk, “Advanced Computer Architectures”, Pearson Education Ltd, 2002.
2. Kai Hwang, “Advanced computer architecture –Parallelism, Scalability Programmability”,McGraw Hill, 1993.

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Professional Elective - III

SYSTEM ON CHIP DESIGN

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concept of System-On-Chip design technology.
- To introduce components in a typical SoC system.
- To familiarize with the concept of different processor cores.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand architecture, design issues, core libraries and EDA tools required for SoC design.
- understand design methodology for logic cores, soft and hard cores, memory and analog cores.
- perform SoC design validation, prototyping and verification.

Course Content

UNIT–I: Introduction to Architecture Designs

Architecture and design issues of SoC, hardware software co-design, co-design flow, core libraries, EDA tools and web pointers.

UNIT–II: Design Methodology for Logic Cores, Soft and Firm Cores

Logic Cores: SoC design flow, guidelines for design reuse and physical design. Soft and Firm Cores: Soft core design flow, design process for hard cores, sign-off checklist, deliverables and system integration.

UNIT–III: Design methodology for Memory Cores and Analog Cores

Memory Cores: Embedded memories and design methodology, specifications of analog circuits, circuit techniques, memory compiler, simulation models.

Analog Cores: Analog-to-digital converter, digital-to-analog converter, phase-locked loops, high speed circuits

UNIT–IV: Design Validation

Core-level validation, core validation plan, test benches, core-level timing verification, core interface verification, protocol verification, gate-level simulation, SoC design validation, co-simulation, emulation, hardware prototypes.

UNIT–V: Core Design Examples

Micro processor cores, V830 R/AV super scalar RISC core, design of power PC603e G2 core, memory core generators, core integration and on-chip bus.

Text Books

1. Rochit Raj Suman, “System-on-a-chip: Design and Test”, Artech House, 2000.

Reference Books

1. Jason Andrews – Newness “Co-Verification of Hardware and Software forARM System on Chip Design (Embedded Technology) “, BK and CDROM.
2. Prakash Rashinkar, Peter Paterson and Leena Singh L “System on ChipVerification – Methodologies and Techniques”, Kluwer Academic Publishers,2001.
3. Ricardo Reis,”Design of System on a Chip: Devices and Components”, 1stEd., Springer 2004.

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Professional Elective - IV

VLSI INTERCONNECTS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart with interconnect issues, parameters and models.
- To familiarize with the concepts of crosstalk effects and advanced interconnect techniques.

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe different types of interconnect models.
- analyse the role of capacitive and resistive parasitics in system performance
- estimate the delay and energy dissipation due cross talk and gain knowledge of cross talk effects.
- apply various techniques to avoid interconnect noise and advanced interconnects.

Course Content

UNIT–I: Interconnects and Wire models

Interconnect Parameters: Resistance, Inductance, and Capacitance, Interconnect RC Delays, Interconnect Models: The ideal wire, The lumped RC Model, the distributed RC Model, the transmission line model.

UNIT–II: Coping with Interconnect

Capacitive Parasitics: Capacitance and Reliability, Capacitance and Performance in CMOS; Resistive Parasitics: Resistance and Reliability— Ohmic Voltage Drop, Electromigration, Resistance and Performance.

UNIT–III: Crosstalk effects

Cross talk induced delay, Energy dissipation due to crosstalk: Model for energy calculation of two coupled lines. Contribution of driver and interconnect to dissipated energy, Crosstalk effects in logic VLSI circuits: Static circuits, Dynamic circuits and various remedies.

UNIT–IV: Techniques for Avoiding Interconnection Noise

Cross talk avoidance: Technology Solution, Interconnection Layout, Driver Sizing, Tolerant circuits; Switching Noise Avoidance: Package Technology, Use of Capacitors, Pin Assignment, Circuit Techniques.

UNIT–V: Advanced Interconnect Techniques

Reduced-swing Circuits: Static Reduced-Swing Networks, Dynamic Reduced-Swing Networks Current-mode Transmission Techniques.

Text Books

1. Jan M. Rabaey, "Digital Integrated Circuits– A design Perspective", Tata McGraw-Hill Education, 2nd Edition, 2003. (Unit – I, II, V).
2. F.Moll, M.Roca, "Interconnection Noise in VLSI Circuits", Kluwer Academic Publishers-2004 Springer (Units - III, IV).

References Books

1. Ashok K. Goel, "High-Speed VLSI Interconnects", 2nd Edition, IEEE Press, Wiley-Interscience publication, 2007.
2. David Hodges, "Analysis and Design of Digital Integrated Circuits", Tata McGraw-Hill Education, 3rd Edition, 2005.
3. Y.S. Diamand, "Advanced Nanoscale ULSI Interconnects: Fundamentals and Applications", 2009
4. H.S Philip Wong and Deji Akinwande, "Carbon nanotube and Graphene Device Physics", 2011.
5. Bakoglu H. B., "Circuit Interconnect and Packaging for VLSI", Addison-Wesley, 1st Edition, 1990.

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Professional Elective - IV

COMMUNICATION BUSES AND INTERFACES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of Serial and Parallel Buses.
- To gain in-depth knowledge of USB and CAN buses.

Course Outcomes

Upon successful completion of the course, the students will be able to

- distinguish serial and parallel buses communication protocols.
- analyze various evolutions of USB interface.
- interface USB 2.0 with embedded processors.
- discriminate various frames in MAC layer of CAN bus.
- apply the CAN bus controllers for different microcontrollers.

Course Content

UNIT – I: Introduction

IO Types and Examples, Serial Communication Devices, Serial Bus Communication Protocols, Parallel Bus Communication Protocols.

UNIT – II: USB Basics and Transfers

USB Basics - Evolution of an USB interface, Bus components; Inside USB Transfers - Transfer basics, Elements of a transfer, USB 2.0 transactions, Ensuring successful transfers.

UNIT – III: USB Enumeration, Descriptors, Components and Hosts

Enumeration-Events and requests-Getting to the Configured state; Descriptors-Types; Chip Choices-Components of a USB device, USB microcontrollers-Microchip PIC18; How the Host Communicates-Device drivers; Hosts for Embedded Systems- The Targeted Host;

UNIT – IV: CAN Bus Concepts and Definitions

Concepts of bus access and arbitration, Error processing and management, From Concept to Reality- Introduction to CAN, The CAN offer: a complete solution; Definitions of the CAN protocol.

UNIT – V: Components, Applications and Tools for CAN

CAN Components- General architecture and functional division of CAN components, List of existing component types, Microcontrollers with integrated CAN handlers: the 8xC592; Applications- Physical and functional divisions of a CAN-based system, CAN central unit with SJA 1000.

Text Books

1. Raj Kamal, "Embedded Systems– Architecture, Programming and Design", McGraw-Hill Education (India) Pvt. Ltd., 2nd Edition, 2013. (Unit – I).
2. Jan Axelson, "USB Complete", 5th Edition, Lakeview Research, 2014. (Units - II, III)

References Books

1. Dominique Paret, "Multiplexed Networks for Embedded Systems", John Wiley & Sons Ltd., 2007. (Units - IV, V)
2. Jan Axelson, "Serial Port Complete", 2nd Edition, Lakeview Research, 2007.
3. Wilfried Voss, Copperhill Media, "A Comprehensive Guide to controller Area Network –Corporation", 2nd Edition, 2005.

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Professional Elective - IV

ADVANCED DIGITAL SIGNAL PROCESSING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with concepts of different types of filter banks and structures.
- To f amiliarize with different adaptive algorithms and its applications on various fields.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the fundamentals of multirate signal processing and its applications.
- design perfect reconstruction filter bank system.
- understand the fundamentals of adaptive systems and its applications.

Course Content

UNIT–I: Basic Multirate Operations

Decimation and interpolation, time-domain characterization, frequency-domain characterization, cascade equivalences, filters in sampling rate alteration systems, polyphase decomposition.

UNIT–II: Filter Banks

Digital filter banks- uniform DFT filter banks, polyphase implementation of uniform filter banks, nyquist filters. two channel Quadrature-Mirror Filter (QMF) bank-filter bank structure, analysis of two channel QMF bank, alias free filter bank, alias free realization, alias free FIR QMF bank, alias free IIR QMF bank, perfect reconstruction two channel QMF bank.

UNIT–III: Adaptive Systems

Adaptive systems- definitions and characteristics- properties, adaptive linear combiner-input signal and weight vectors - performance function-gradient and minimum mean square error.

UNIT–IV: Adaptive Algorithms

Searching performance surface-stability and rate of convergence - learning curve-gradient search - Newton's method - method of steepest descent – comparison. LMS algorithm- convergence of weight vector. The LMS/Newton algorithm.

UNIT – V: Applications of Adaptive Systems

Applications-adaptive modeling and system identification-adaptive modeling for multipath communication channel, geophysical exploration, FIR digital filter synthesis.

Text Books

1. Sanjit K. Mitra, " Digital Signal Processing: A computer based approach", McGraw Hill, 1998. (Units – I, II).
2. Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, 2005. (Units – III, IV, V).

Reference Books

1. P.P. Vaidyanathan, "Multirate Systems and Filter Banks." Prentice Hall.PTR. 1993.
2. Simon Haykin, "Adaptive Filter Theory", Pearson Education, 2003.
3. J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles.Algorithms and Applications", 3rd Edn. Prentice Hall India, 1999.
4. N.J. Fliege. "Multirate Digital Signal Processing " John Wiley 1994.

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Professional Elective - V

LOW POWER VLSI DESIGN

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To make the students to gain in depth knowledge with the sources of power dissipation and power minimization techniques.
- To make them familiarize with advanced low power design techniques

Course Outcomes

Upon successful completion of the course, the students will be able to

- describe the requirements for low power and distinguish static and dynamic power dissipations
- apply voltage scaling approaches to reduce dynamic power
- apply various techniques to minimize switched capacitance
- identify suitable leakage power minimization technique
- analyze modern low power design methodologies such as adiabatic circuits.

Course Content

UNIT–I: Low Power Requirements and Sources of Power Dissipation

Historical background, requirements for low power, sources of power dissipation, low power design methodologies, Short circuit power dissipation, switching power dissipation, glitching power dissipation, leakage power dissipation.

UNIT–II: Supply Voltage Scaling Approaches

Device feature size scaling, architectural level approaches, voltage scaling using high-level transformations, multilevel voltage scaling.

UNIT–III: Switched Capacitance Minimization Approaches

Hardware software trade-off, bus encoding, clock gating, glitching power minimization, logic styles for low power.

UNIT–IV: Leakage Power Minimization Approaches

Variable-Threshold voltage CMOS (VTCMOS) approach, transistor stacking, Multi-Threshold-voltage CMOS (MTCMOS) approach, power gating.

UNIT – V: Adiabatic Logic Circuits

Adiabatic charging, adiabatic amplification, adiabatic logic gates, pulsed power supply, partially adiabatic circuits.

Text Books

1. Jan M. Rabaey and Massoud Pedram, "Low Power Design Methodologies", Kluwer Academic Publishers, 1996 (Unit - I).
2. Ajit Pal, "Low Power VLSI Circuits and Systems", Springer India, 2015. (Units - II to V).

Reference Books

1. Sung Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata Mcgraw Hill, Third Edition.
2. Neil H. E. Weste and K. Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley (Indian reprint), Second Edition.
3. A. Bellamour and M. I. Elmasri, "Low Power VLSI CMOS Circuit Design", Kluwer Academic Press, 1995.
4. Anantha P. Chandrakasan and Robert W. Brodersen, "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995.
5. Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Design", Wiley-Interscience, 2000.
6. Prof. Ajit Pal, Department of Computer Science and Engineering, IIT Kharagpur, Low Power VLSI Circuits & Systems, NPTEL video course.

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Professional Elective - V

NETWORK SECURITY AND CRYPTHOGRAPHY

III Semester

Lecture	: 3		Internal Marks	:	30
Credits	: 3		External Marks	:	70

Course Objectives

- To familiarize with fundamentals of cryptography and its application to network security.
- To introduce the concept of Hash functions and IP security

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand various Cryptographic Techniques
- apply various public key cryptography techniques.
- implement Hashing and Digital Signature techniques.
- understand the various types of Web Security.

Course Content

UNIT–I: Introduction & Symmetrical Ciphers

OSI Security architecture, Security attacks, Security services, Security Mechanisms, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography ,Rotor Machines, symmetrical cipher model, substitution Techniques, transposition Techniques, Traditional Block Cipher structure, Block cipher Design Principles, Block cipher Operation.

UNIT–II: Classical Encryption Techniques

The Data Encryption Standard (DES), DES Example, the strength of DES, Advanced Encryption Standard(AES), AES structure, AES Transformation Functions, AES Example, AES Implementation, Multiple Encryption and Triple DES.

UNIT–III: Public Key Cryptography

Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography. Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primarily, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.

UNIT–IV: Message Authentication and Hash Functions

Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs. Hash and Mac Algorithms: MD File, Message digest Algorithm, Secure Hash Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards. Authentication Applications: Kerberos, Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT–V: IP Security

Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction. Intruders, Viruses and Worms: Intruders, Viruses and Related threats. Fire Walls: Fire wall Design Principles, Trusted systems.

Text Books

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, 6th Edition, Pearson Education, 2013.
2. William Stallings, “Network Security Essentials (Applications and Standards)”, 4th Edition, Pearson Education.

Reference Books

1. Terry D. Pardoe, Gordon Snyder, “Network Security”, Thomson/Delmar Learning, 2005.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security (SIE)”, Tata Mcgraw-Hill Education Private Limited, 2011.

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Professional Elective – I

DIGITAL IMAGE PROCESSING

I Year – I Semester

Lecture: 3 Internal Marks: 40

Credits: 3 External Marks: 60

Course Objectives

- To describe and explain basic principles of digital image processing
- To discuss various image processing techniques.

Course Outcomes

Upon completion of the course students will be able to

- use appropriate image enhancement technique to improve the quality of an image.
- apply suitable image segmentation technique for an application.
- analyze various image compression techniques.
- apply morphological operations to modify the structure of an image.

UNIT- I: Introduction

Digital image processing, examples of fields that use digital image processing,fundamental steps in digital image processing.

Digital Image Fundamentals- Image sensing and acquisition, sampling and quantization,basic relationships between pixels.

UNIT- II:Image Enhancement in the Spatial Domain

Introduction, Basic gray-leveltransformations, histogram processing, enhancement using arithmetic and logic operators.Basics of spatial filtering, smoothing and sharpening spatial filters, combining the spatialenhancement methods.

UNIT –III: Color Image Processing

Introduction, color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transformations, color image smoothing and sharpening, color segmentation.

UNIT –IV: Image Compression

Fundamentals, image compression models, error-free compression, lossy predictive coding.

UNIT- V: Morphological Image Processing

Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms

Image Segmentation: Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation.

Text Books

1. RafealC.Gonzalez, Richard E.Woods,"Digital Image Processing", 2 nd Edition, Pearson Education/PHI.

Reference Books

1. Milan Sonka, Vaclav Hlavac and Roger Boyle,"Image Processing, Analysis, and
2. Machine Vision", 2nd Edition, Thomson Learning.
3. Adrian Low,"Computer Vision and Image Processing", 2nd Edition, B.S.Publications
4. William K. Prat,"Digital Image Processing", Wily 3rd Edition

Professional Elective – I

AD HOC AND SENSOR NETWORKS

I Year – I Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- Acquire the knowledge of various techniques in mobile networks/Adhoc networks and sensor based networks.
- The objective of this course is to facilitate the understanding of Infrastructure less networks and their importance in the future directions for wirelesscommunications

Course Outcomes

Upon completion of the course students will be able to

- explain the Fundamental Concepts and applications of ad hoc and wireless sensornetworks
- describe the MAC protocol issues of ad hocnetworks
- describe routing protocols for ad hoc wireless networks with respect to TCP designissues
- explain the concepts of network architecture and MAC layer protocol forWSN
- discuss the WSN routing issues by considering QoSmeasurements

UNIT I: Introduction

Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms ,Characteristics of the Wireless channel mobile ad hoc networks (MANETs), Wireless Sensor Networks (WSNs): concepts and architectures, Applications of Ad Hoc and Sensor Networks, Design Challenges in Ad hoc and Sensor Networks.

UNIT II: MAC Protocols For Ad Hoc Wireless Networks

Issues in designing a MAC Protocol, Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based protocols, Contention based protocols with Reservation Mechanisms, Contention based protocols with Scheduling Mechanisms, Multi channel MAC - IEEE802.11.

UNIT III: Routing Protocols And Transport Layer In Ad Hoc Wireless Networks

Routing Protocol: Issues in designing a routing protocol for Ad hoc networks, Classification, proactive routing, reactive routing (on-demand), hybrid routing, Transport Layer protocol for Ad hoc networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer solutions- TCP over Ad hoc wireless, Network Security, Security in Ad Hoc Wireless Networks, Network Security Requirements.

UNIT IV: Wireless Sensor Networks (WSNS) And Mac Protocols

Single node architecture - hardware and software components of a sensor node, WSN Network architecture: typical network architectures, data relaying and aggregation strategies, MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC - IEEE802.15.4.

UNIT V: WSN Routing, Localization &Qos

Issues in WSN routing, OLSR, Localization, Indoor and Sensor Network Localization, absolute and relative localization, triangulation, QOS in WSN, Energy Efficient Design, Synchronization.

Text Books

1. "Ad Hoc Wireless Networks: Architectures and Protocols ", C. Siva Ram Murthy, and B. S. Manoj, Pearson Education,2008
2. “Wireless Adhoc and Sensor Networks”, Labiod. H, Wiley, 1stedition-2008
3. “Wireless ad -hoc and sensor Networks: theory and applications”, Li, X, Cambridge University Press, fifthedition-2008.

Reference Books

1. “Ad Hoc & Sensor Networks: Theory and Applications”, 2nd edition, Carlos De MoraisCordeiro, Dharma PrakashAgrawal ,World Scientific Publishing Company,2011
2. "Wireless Sensor Networks", Feng Zhao and LeonidesGuibas,Elsevier Publication 2ndedition-2004
3. “Protocols and Architectures for Wireless Sensor Networks”, Holger Karl and Andreas Willig,Wiley, 2005 (soft copyavailable)
4. “Wireless Sensor Networks Technology, Protocols, and Applications”, KazemSohraby, Daniel Minoli, &TaiebZnati, John Wiley, 2007. (soft copyavailable)

Professional Elective – I

INTELLIGENT SYSTEMS
I Year – I Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- Understand the fine structure or deeper origin of knowledge
- Generate intelligent behavior on the basis of statistical evidence.

Course Outcomes

Upon completion of the course students will be able to

- demonstratedata representation and logical operations.
- analyze backward reasoning and solve problems by reduction.
- design and develop rule based system for the given data
- explain the architecture of real time expert systems.
- demonstrate qualitative simulation on the data

UNIT I: Knowledge Representation

Data and knowledge: Data representation and data items in traditional databases, Data representation and data items in relational databases. Rules: Logical operations, Syntax and semantics of rules, Data log rule sets, the dependence graph of data log rule sets, objects.

UNIT II: Rule Based Systems

Solving problems by reasoning: The structure of the knowledge base, the reasoning algorithm, Conflict resolution, Explanation of the reasoning.

Forward reasoning: The method of forward reasoning, a simple case study of forward reasoning, backward reasoning: Solving problems by reduction, the method of backward reasoning, a simple case study of backward reasoning, Bidirectional reasoning.

UNIT III: Verification and Validation of Rule Bases

Contradiction freeness: The notion of contradiction freeness, Testing contradiction freeness, The search problem of contradiction freeness .Completeness: The notion of completeness, Testing Completeness, The search problem of completeness. Decomposition of knowledge bases: Strict decomposition, Heuristic decomposition.

UNIT IV: Real-Time Expert Systems

The architecture of real-time expert systems: The real-time subsystem, The intelligent subsystem Synchronization and communication between real-time and intelligent subsystems: Synchronization and communication primitives, Priority handling and time-out. Data exchange between the real-time and the intelligent subsystems: Loose data exchange, the blackboard architecture. Software engineering of real- time expert systems: The software lifecycle of real time expert systems, Special steps and tool, An Example of A Real-Time expert System.

UNIT V: Qualitative Reasoning

Sign and interval calculus, Qualitative simulation: Constraint type qualitative differential equations, The solution of QDEs: the qualitative simulation algorithm: Initial data for the simulation, Steps of the simulation algorithm, Simulation results. Qualitative physics, Signed directed graph (SDG) models.

Text Books

1. Intelligent Control Systems-An Introduction with Examples by Katalin M. Hangos, RozáliaLakner ,MiklósGerzson, Kluwer Academic Publishers.
2. Intelligent Systems and Control: Principles and Applications Paperback – 12 Nov 2009 by LaxmidharBehera, IndraniKar by OXFORD.

References Books

1. Intelligent Systems and Technologies Methods and Applications by Springer publications.
2. Intelligent Systems - Modeling, Optimization and Control, by Yung C. Shin and ChengyingXu, CRC Press, Taylor & Francis Group,2009.

Professional Elective –II

INTERNET OF THINGS
I Year – I Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- To understand smart objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and RaspberryPi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

Course Outcomes

Upon completion of the course students will be able to

- summarize on the term 'internet of things' in differentcontexts.
- analyze various protocols forIoT.
- design a PoC of an IoT system using Rasperry Pi/Arduino
- apply data analytics and use cloud offerings related to IoT.
- analyze applications of IoT in real timescenario

UNIT I: Fundamentals of IoT

Evolution of Internet of Things, Enabling Technologies, IoT Architectures,oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II: IoTProtocols: IT Access Technologies

Physical and MAC layers, topology of IEEE 802.15.4, Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAPandMQTT.

UNIT III: Design and Development

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino. Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with PythonProgramming.

UNIT IV: Data Analytics and Supporting Services

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Xively Cloud for IoT, Python Web Application Framework, Django.

UNIT V: Case Studies

Cisco IoT system, IBM Watson IoTplatform, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

Reference Books

1. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press,2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
3. “From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence”, JanHo¨ller,VlasiosTsiatsis,CatherineMulligan,Stamatis,Karnouskos,StefanAvesand.Davidoyle and Elsevier, 2014.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
5. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O’Reilly Media,2011.

Professional Elective –II

PRINCIPLES OF COMPUTER SECURITY

I Year – I Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- To impart knowledge on modern cryptographic theories and techniques, mainly focusing on their application into real systems.
- To provide basic terms and concepts in Database and Cloud Security, Denial-of-Service Attacks and Operating System Security.

Course Outcomes

Upon completion of the course students will be able to

- analyze and evaluate the computer security needs of an organization.
- determine and analyze user authentication principles and security techniques to reduce the risk of exploitation.
- implement database and cloud security solutions for recent developments.
- describes issues concerning software development and implementation, including operating systems, utilities, and applications
- describes the application security requirements in operating systems.

UNIT I: Introduction

Computer Security Concepts, Threats, Attacks, and Assets, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy. Cryptographic Tools: Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption.

UNIT II: User Authentication

Electronic User Authentication Principles, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Security Issues for User Authentication.

UNIT III: Database and Cloud Security

The Need For Database Security, Database Management Systems, Relational Databases, Sql Injection Attacks, Database Access Control, Database Encryption, Cloud Computing, Cloud Security Risks And Countermeasures, Data Protection In The Cloud, Cloud Security As A Service.

UNIT IV: Denial-of-Service Attacks

Denial-of-Service Attacks, Flooding Attacks, Distributed Denial- of-Service Attacks, Application-Based Bandwidth Attacks, Reflector and Amplifier Attacks, Defenses Against Denial-of-Service Attacks, Responding to a Denial-of-Service Attack. Software Security: Software Security Issues, Handling Program Input, Writing Safe Program Code.

UNIT V: Operating System Security

Introduction to Operating System Security, System Security Planning, Operating Systems Hardening, Application Security, Security Maintenance, Linux/Unix Security, Windows Security, Virtualization Security.

Text Book

1. Computer Security: Principles and Practices, 3e, William Stallings, Lawrie Brown, Pearson

Reference book

1. Network Security Essentials, Principles and Practices, William Stallings, Pearson

Professional Elective –II

DISTRIBUTED SYSTEMS

I Year – I Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- To familiarize with differentdistributed systems and theirarchitectures.
- To explain different communication mechanisms and their advantages and disadvantages.

Course Outcomes

Upon completion of the course students will be able to

- explain resource sharing in distributed systems and different system models used to construct distributed system network betweensystems
- illustrate distributed objects and remoteinvocation
- explore functional distributed filesystems
- explain distributed transaction management, coordination and agreement between distributedprocesses
- design a distributed system that fulfills the requirements.

UNIT I: Characterization of Distributed Systems

Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges. (6 hours) System Models: Introduction, Architectural Models- Software Layers, System Architecture, Variations, Interface and Objects, Design Requirements for Distributed Architectures, Fundamental Models- Interaction Model, Failure Model, Security Model.

UNIT II: Distributed Objects and Remote Invocation

Introduction, Communication between Distributed Objects- Object Model, Distributed Object Model, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection; Remote Procedure Call, Events and Notifications.

UNIT III: Distributed File Systems

Introduction, File Service Architecture; Peer-to-Peer Systems: Introduction, Napster and its Legacy, Peer-to-Peer Middleware.

UNIT IV: Coordination and Agreement

Introduction, Distributed Mutual Exclusion, Elections, Multi-cast Communication.

UNIT V: Transactions & Replications

Introduction, System Model and Group Communication, Concurrency Control in Distributed Transactions, Distributed Dead Locks, Transaction Recovery; Replication-Introduction, Passive (Primary) Replication, Active Replication.

Text Books

1. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems- Concepts and Design”, Fourth Edition, PearsonPublication
2. Ajay D Kshemkalyani, MukeshSighal, “Distributed Computing, Principles, Algorithms and Systems”, Cambridge

Reference Books

1. Andrew S. Tanenbaum, Maarten Van Steen - Distributed Systems principlesand paradigms.

Professional Elective –III

BLOCKCHAIN TECHNOLOGY

I Year – II Semester

Lecture: 3 Internal Marks: 40

Credits: 3 External Marks: 60

Course Objectives

- Understand how block chain systems (mainly Bit coin and Ethereum) work
- To securely interact with them.
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their ownprojects.

Course Outcomes

Upon completion of the course students will be able to

- demonstrate the foundation of the Block chain technology and understand the processes in payment andfunding.
- identify the risks involved in building Block chainapplications.
- review of legal implications using smartcontracts.
- choose the present landscape of Blockchain implementations and Understand cryptocurrency markets
- examine how to profit from tradingcryptocurrencies.

UNIT – I

The consensus problem ,Asynchronous Byzantine Agreement ,AAP protocol and its analysis,Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model ,RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).

UNIT – II

Cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.

UNIT – III

Bitcoin, Wallet, Blocks, Merkley Tree, hardness of mining,transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

UNIT – IV

Ethereum - Ethereum Virtual Machine (EVM) ,Wallets for Ethereum - Solidity , Smart Contracts , some attacks on smart contracts.

UNIT – V

(Trends and Topics) - Zero Knowledge proofs and protocols in Blockchain, Succinct non interactive argument for Knowledge (SNARK), pairing on Elliptic curves, Zcash.

Text Books

1. Aravind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016. (Free download available)

Reference Books

1. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015 (article available forfreedownload) { curtain raiser kind of generic article, written by seasoned experts and pioneers}.
2. J. A. Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310. (Also available at eprint.iacr.org/2016/1048). (serious beginning of discussions related to formal models for bitcoinprotocols).
3. R. Pass et al, Analysis of Blockchain protocol in Asynchronous networks, EUROCRYPT 2017, (eprint.iacr.org/2016/454). A significant progress and consolidation of severalprinciples).

Professional Elective –III

DATA PREPARATION AND ANALYSIS

I Year – II Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objective

- To prepare the data for analysis and develop meaningful Data Visualizations

Course Outcome

Upon completion of the course students will be able to

- extract the data for performing the analysis
- handle missing data by choosing appropriate technique
- apply the concept of clustering and association to analyze this statistical data
- apply techniques reallocated/ geolocated data
- summarize the data using basic statistics and visualize the data using basic graphs and plots.

UNIT – I: Data Gathering and Preparation

Data formats, parsing and transformation, Scalability and real-time issues

UNIT – II: Data Cleaning

Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

UNIT – III: Exploratory Analysis

Descriptive and comparative statistics, Clustering and association, Hypothesis generation

UNIT – IV: Visualization

Designing visualizations, Time series, Reallocated data, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

UNIT - V

Visualizations using R:- Exporting data, importance of box plots, plotting bar charts, plotting multiple variables_scatter plots, dealing with time-series plots.

Textbooks

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Reference Text books:

1. Exploratory Data mining and Data Cleaning, by Tamraparni DSU, Theodore Jhonson.
2. Visualizing Data: Exploring and Explaining Data with the Processing Environment by Ben Fry.

Professional Elective –III

NATURAL LANGUAGE PROCESSING

I Year – II Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objective

- To familiarize the fundamental concepts and techniques of natural language processing (NLP).
- To impart knowledge on NLP models and algorithms using both the traditional symbolic and the more recent statisticalapproaches.

Course Outcome

Upon completion of the course students will be able to

- demonstrate PoS tagging on a given text with basic Languagefeatures
- to design an innovative application using NLP components
- explain a rulebased system to tackle morphology/syntax of alanguage
- to design a tag set to be used for statistical processing for real-timeapplications
- to compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT - I:Introduction

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT - II:Word Level Analysis

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT - III: Syntactic Analysis

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of featurestructures

UNIT - IV: Semantics and Pragmatics

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT - V:Discourse Analysis and Lexical Resources

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2ndEdition, Daniel Jurafsky, James H. Martin—Pearson Publication,2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books

1. Language Processing with Java and LingPipe Cookbook, 1stEdition, Breck Baldwin, Atlantic Publisher,2015.
2. Natural Language Processing with Java, 2ndEdition, Richard M Reese, OReilly Media,2015.
3. Handbook of Natural Language Processing, Second, NitinIndurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rdEdition, TanveerSiddiqui, U.S. Tiwary, Oxford University Press,2008.

Professional Elective –IV

CLOUD COMPUTING
I Year – II Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- To provide the architectural concepts of cloud computing.
- To familiarize with cloud service models and cloud based applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- differentiate the stages in historical evolution of cloud computing.
- use suitable cloud services to define cloud for the enterprise.
- demonstrate OS level virtualization to implement virtual machines.
- design machine images, web applications and databases for virtual machines.
- apply data, network and host security for the cloud**.**

UNIT - I: Cloud Computing

Introduction, cloud computing: What it is and what it isn't, from collaboration to the cloud : A short history of cloud computing, the network is the computer: How cloud computing works, understanding cloud architecture , storage, services; The pros and cons of cloud computing. Who benefits from cloud computing? who shouldn't be using cloud computing.

UNIT - II: Defining Clouds for the Enterprise

Storage-as-a-Service, Database-as-a-Service, Information-as-a-Service, Process-as- a-Service, Application-as-a-Service, Platform-as-a-Service, Security-as-a-service, Infrastructure-as-a-Service.

UNIT - III: Virtual Machines and Virtualization

Implementation levels of virtualization: levels of virtualization implementation,VMM design requirements and providers, virtualization support at the OS level, virtualization structures/tools and mechanisms: Hypervisor and Xen architecture, binary transition with full virtualization, para-virtualization with compiler support.

UNIT-IV: Data Center to Cloud

Move into the cloud, know your software licenses, the shift to a cloud cost model, service levels for cloud applications.

UNIT - VI: Security

Data Security: data control, encrypt everything, regulatory and standards compliance; Network Security: firewall rules, network intrusion detection; Host Security: system hardening, antivirus protection, host intrusion detection, data segmentation, credential management; Compromise response.

Text Books

1. Kai Hwang, Jack Dongarra and Geoffrey C.Fox, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", 1st edition, Morgan Kaufman Publications.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", 1st edition, O'Reilly.

Reference Books

1. Michael Miller, "Cloud Computing- Web Based Applications That Change the Way You Work and Collaborate Online", 1st edition, Que publications.
2. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide" Addison Wesley.

Professional Elective –IV

QUANTUM COMPUTING
I Year – II Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objective

- To impart necessary knowledge to the learner for developing and implementing algorithms and write programs using these algorithms.

Course Outcomes

Upon completion of the course students will be able to

- explain the working of a quantum computing program, its architecture and program
- model develop quantum logic gate circuits
- develop quantum algorithm
- program quantum algorithm on major toolkits

UNIT-I: Introduction to Quantum Computing

Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing Qubits and multi-qubits states, Bra-ket notation; Bloch Sphere representation; Quantum Superposition; Quantum Entanglement.

UNIT-II: Math Foundation for Quantum Computing

Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

UNIT -III: Building Blocks for Quantum Program

Architecture of a Quantum Computing platform.

Details of q-bit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates, Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc.

Programming model for a Quantum Computing Program Steps performed on classical Computer: Steps performed on Quantum Computer, Moving data between bits and qubits.

UNIT-IV: Quantum Algorithms

Basic techniques exploited by quantum algorithms- Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks.

Major Algorithms- Shor’s Algorithm; Grover’s Algorithm; Deutsch’s Algorithm;Deutsch - Jozsa Algorithm.

OSS Toolkits for implementing Quantum program IBM quantum experience- Microsoft Q, RigettiPyQuil (QPU/QVM)

Textbooks

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University Press.
2. David McMahon, “Quantum Computing Explained”, Wiley
3. IBM Experience: https://quantumexperience,ng,bluemix.net

Reference Books

1. Microsoft Quantum Development Kit https://www.microsoft.com/en-us/quantum/development-kit
2. Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/

Professional Elective –IV

DIGITAL FORENSICS

I Year – II Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- To provide an in-depth study of the rapidly changing and fascinating field ofcomputer
- To impart the knowledge required to investigate, detect and prevent digitalcrimes by combining both the technical expertise.
- To impart knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.

Course Outcomes

Upon completion of the course students will be able to

- understand relevant legislation and codes of ethics
- computer forensics and digital detective and various processes, policies andprocedures
- E-discovery, guidelines and standards, E-evidence, tools.
- Email and web forensics and networkforensics.

UNIT -I: Digital Forensics

Forensic science, computer forensics, and digital forensics,

Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

UNIT -II: Cyber Crime Scene Analysis

Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrievedcommunications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT -III: Evidence Management and Presentation

Create and manage shared folders using operating system, importance of the forensic mindset, define the workloadof law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT -IV: Computer Forensics

Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation,and complete a case, Critique a case,Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT -V: Mobile Forensics

Mobile forensics techniques, mobile forensics tools.

Legal Aspects of Digital Forensics:IT Act 2000, amendment of IT Act 2008, Recent trends in mobile forensic technique and methods to search and seizure, electronic evidence.

Text Book

1. The Basics of Digital Forensics, John Sammons, 2nd edition, Elsevier, 2014.

Reference Books

1. Digital Forensic: The Fascinating world of digital evidences, 1st Edition, Nilakshi Jain, DhananjayR.kalbande, wiley-2016

Professional Elective – V

DEEP LEARNING
II Year – I Semester

Lecture: 3 Internal Marks: 40
Credits: 3 External Marks: 60

Course Objectives

- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- To explore supervised and unsupervised learning paradigms of machine learning.

Course Outcomes

Upon completion of the course students will be able to

- explore Deep learning techniques and various feature extraction strategies.
- mathematically understand the deep learning approaches and paradigms
- apply the deep learning techniques for various applications

UNIT I: Basics

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability.Convergence theorem for Perceptron Learning Algorithm.

UNIT II: Feedforward Networks

Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.
Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.

UNIT III: Better Training of Neural Networks

Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT IV: Recurrent Neural Networks

Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs
Convolutional Neural Networks: LeNet, AlexNet.
Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V: Recent trends

VariationalAutoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning
Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

Textbooks

1. Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.

References

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

Professional Elective – V

RECOMMENDER SYSTEMS

II Year – I Semester

Lecture: 3	Internal Marks: 40
Credits: 3	External Marks: 60

Course Objectives

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
- To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

Course Outcomes

Upon completion of the course students will be able to

- design recommendation system for a particular application domain.
- evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity
- explain User-based recommendation, knowledge-based recommender system
- define Opportunities for hybridization, Monolithic hybridization
- identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization

UNIT-I: Introduction

Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II: Content-based Filtering

High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT-III: Collaborative Filtering

User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems. Types of Recommender Systems: Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems

UNIT-IV: Hybrid Approaches

Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations of hybridization strategies.

UNIT-V: Evaluating Recommender System

Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

Text Books

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1sted.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1sted.

Reference Books

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1sted.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1sted.

Specialisation - Marketing

ADVERTISING AND BRAND MANAGEMENT

III - Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand concept of advertising and its role in marketing communication.
- To provide a working knowledge of the major framework, theories to create and evaluate effective advertising strategies and tactics.
- To enlighten the students with the concepts and practical applications of Brand Management.

Course Outcomes

Upon successful completion of the course, students will be able to

- develop an integrated advertising and marketing communications plan and persuasively present and defend it.
- identify and make decisions regarding the most feasible advertising appeal and media mix.
- evaluate critically advertising budgets to develop creative solutions for improvement of ad effectiveness
- gaining knowledge in development and management of customer-based brand equity.
- understanding effective design and implementation of branding and positioning strategies.

UNIT - I: Role of Advertising in Promotional Mix

Introduction to Advertising –Advertising and Communication–Integrated Marketing Communication (IMC) – Challenges and Opportunities in Advertising – Economic, Social and Ethical Aspects of Advertising. Direct Response Advertising-Direct Mail, Internet Advertising - Case Study.

UNIT - II: Audience Analysis in Advertising

Media Planning – Media Mix Decisions – Developing Media Strategy – Creative Strategy and Copy Writing – Different Types of Appeals – Layout Design. Advertising and Consumer Behaviour - Case Study,

UNIT - III: Advertising Budgets

Setting Advertising Objectives- DAGMAR Approach- Advertising Budgets, Methods of Formulating Advertising Budgets- Evaluating of Advertising Effectiveness- Advertising Agencies - Case Study.

UNIT - IV: Brand Concept

Nature and Importance of Brand- Designing Brand Marketing Programmes- Brand Identity- (Aaker Model)- Brand Loyalty, Measures of Loyalty- Brand Equity, Brand Personality: Measures of Brand Personality, Formulation of Brand Personality- Brand Image Vs Brand Personality - Case Study.

UNIT - V: Brand Positioning

Concept of Brand Positioning- Repositioning- Brand Rejuvenation- Celebrity Endorsement, Brand Extension- Differential Advantage- Strategies for Competitive Advantage- Brand Pyramid - Case Study.

Text Books

1. George E Belch, Michael A Belch and Keyoor Purani, Advertising and Promotion, Tata McGraw Hill, 7th edition, 2009.
2. S.A. Chunawalla and K.C. Sethia, Foundations of Advertising - Theory & Practice, 8th revised edition, Himalaya Publishing House Pvt. Ltd. , 2015.
3. Aaker, David (2002), Managing Brand Equity, Prentice Hall of India.
4. Kevin Lane Keller, Jacob Isaac and Ambi M. G. Parmeswaran, Strategic Brand Management, 3rd edition, Pearson Education India, 2010.

Reference Books

1. John. S. Wright Wills. L. Winter, Jr. and Sherliyer K. Zeigler, Advertising – Tata Mc Graw Hill.
2. William Wills, John Burnett and Sandra Mriarty – Advertising Principles and Practice – Pearson, ND.
3. Percy & Elliot – Strategic Advertising Management, Oxford University Press.
4. Harsh V. Varma, Brand Management, Excel Books.
5. Kumar, Ramesh (2004). Managing Indian Brands, Vikas Publishing House, New Delhi.

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Specialisation - Marketing

CONSUMER BEHAVIOUR

III - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To enable the students in understanding consumer behavior for marketing decisions.
- To design primary market research studies for the mutual benefit of consumers and organizations.
- To analyze personal socio-cultural and environmental dimentions that influence consumer decission making.

Course Outcomes

Upon successful completion of the course, students will be able to

- identify the dynamics of consumer behavior and understand the changes in consumer behavior through research process.
- understand the role of Personality, perception and attitude and socio-cultural factors in shaping consumer behaviour.
- relate the impact of Socio-Cultural Influences on Consumer Behavior
- acquaint with the consumer decision making models.
- identify the roots of consumerism and understand consumer ethics.

UNIT - I: Understanding Consumer Behaviour

Defining Consumer Behaviour, Need for the Study of Consumer Behaviour. Consumer Behavior in a World of Economic Instability. Rural Consumer Behaviour, Diversity of Indian Market and Changing Indian Consumer Behaviour. Understanding Consumer through Research Process - Case Study.

UNIT - II: Consumer as an Individual

Consumer Personality and Self-concept, Consumer Motivation, Consumer Perception, Consumer Beliefs, Consumer Attitude- Formation and Change, Consumer Learning and Information Processing- Case Study.

UNIT - III: Socio-Cultural Influences on Consumer Behavior

Influence of Culture, Sub Culture, Social Class, Reference Groups, Family and Personality. Cross-Cultural Consumer Behaviour- Case Study.

UNIT - IV: Consumer Decision Making Processes

Problem Recognition, Search and Evaluation, Purchasing Processes, Post Purchase Behaviour. Consumer Decision Making Models. Consumers and the Diffusion of Innovations- Case Study.

UNIT - V: Consumerism and Ethics

Consumerism and its roots, evolution of consumerism in India. Consumer Safety, Consumer Information, Consumer Responsibilities, Marketer Responses to Consumer Issues, Marketing Ethics towards Consumers- Case Study.

Text Books

1. Leon G. Schiffman, Leslie Lazer Kanuk, S. Ramesh Kumar, Consumer Behaviour Pearson, Tenth edition, 2011.
2. David L. Loudon and Albert J. Della Bitta, Consumer Behaviour, TMH, Fourth Edition.
3. Ramanuj Majumdar, Consumer Behaviour, PHI, 2011.
4. Suja R Nair, Consumer Behaviour in Indian perspective, 2nd edition, HPH, 2013.

Reference Books

1. Michael R. Solomon Consumer Behaviour, Tenth Edition, PHI, 330-331.
2. Satish Batra, SHH kazmi, Consumer Behaviour-Text and Cases, Excel Books, Second Edition, 2011.
3. Kardes, Cline, Cronley, Consumer Behaviour-Science and Practice, Cengage Learning, 2012.
4. S. Ramesh kumar, Consumer Behaviour and Branding, Pearson, 2013.
5. Dr. Shri Prakaash, Consumer Behaviour, Vikas 2010.
6. S.A. Chunawalla, Commentary on Consumer Behaviour, 3rd edition, HPH 2012
7. S.H.H.Kazmi, Consumer Behaviour and Marketing Communication, Excel 2011.
8. Ramneek Kapoor, N.Namdi O Madichie, Consumer Behaviour, TMH 2012
9. J. Paul Peter, Jerry. C. Olsan, Consumer Behaviour and Marketing Strategy 7th Edition, TMH 2011.

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Specialisation - Finance

SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

III - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the basic concepts of different kinds of markets & various investment alternatives available.
- To acquaint the students about investment decisions related to financial assets, the risks and the returns involved, alongside the theories and concepts involved in portfolio management.
- To draw reasoned conclusions in selecting and presenting information on securities.

Course Outcomes

Upon successful completion of the course, students will be able to

- provide a theoretical background in the field of investments.
- analyse the risk & return of the various combinations of the funds invested in the portfolio.
- selecting the optimum securities on the basis of technical & fundamental analysis.
- evaluation of bond duration, volatility for buys, holds or sells decision.
- apply the knowledge of dividend discount model, mutual funds in evaluating the securities.

UNIT - I: Investments

The investment environment, classification and functions of financial markets and financial instruments. Securities trading – types of orders, margin trading, clear-ing and settlement procedures. Regularity systems for equity markets - Case study.

UNIT - II: Portfolio Management

Concept of Risk, measuring risk and returns, Portfolio risk – measurement and analysis, mean – variance approach, business risk and financial risk and treat-ment in portfolio management- The Capital Asset Pricing Model, Single-index model, Arbitrage Pricing theory, Market Efficiency.

UNIT - III: Bond Valuation

Bond Analysis: Bond Pricing Theorems, Convexity, duration, bond immunization, active bond management and passive bond management. - Case study.

UNIT - IV: Fundamental Analysis & Technical Analysis

Economic analysis: Factors in Domestic and International economy – Economic forecasting and stock-investment decisions – Types of economic forecasts – Fore-casting techniques -Industry analysis: classification – Key characteristics in in-dustry analysis – Sources of information for industry analysis. Company analy-sis: Sources of information for company analysis (Internal, External) – Factors in company analysis – Operating analysis – Management analysis – Financial analy-sis - Technical Analysis.

UNIT - V: Security Analysis

Dividend discount models, intrinsic value and market price, earnings multiplier approach, P/E ratio, Price/ Book value, Price/sales ratio. Mutual Funds – Intro-duction, Features & Importance, Types, Performance evaluation of Mutual Funds - Treynor, Sharpe and Jensen Measures - case study.

Text Books

1. Punithavathy Pandian: Security Analysis and Portfolio Management, Vikas Publishing House, New Delhi, 2014.
2. Prasanna Chandra, Investment Analysis and Portfolio Management, 3/e Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2009
3. S. Kevin: Security Analysis and Portfolio Management, PHI Learning, New Delhi, 2015.

Reference Books

1. V.K. Bhalla: Investment Analysis and Portfolio Management, S.Chand, 2016.
2. Thomos S Y Ho: Security valuation, Oxford University Press, New Delhi, 2009.
3. Edwin J. Elton, Martin J. Gruber: Modern Portfolio Theory and Investment Analysis, 5/e, John Wiley & Sons, 2001.

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Specialisation - Finance

INTERNATIONAL FINANCIAL MANAGEMENT

III - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To determine trading through the exchange of foreign currency and international dealings with overseas business partners.
- To provide knowledge on Forex markets and able to execute a speculative transaction in markets.
- To forecast and evaluate future cash flows by using asset liability management.

Course Outcomes

Upon successful completion of the course, students will be able to

- understand the various theories in International Business.
- gain the knowledge on the flow of funds between countries.
- analyze the stages in International Monetary system.
- know trade in the exchange markets such as central banks, speculators, corporations and individuals make up speculation techniques
- understand relationship between inflation, interest rates and exchange rates.

UNIT - I: International Financial Management

An overview, Importance, nature and scope, Theories of International business, International Business Methods, Recent changes and challenges in IFM; Case study.

UNIT - II: International Flow of Funds

Balance of Payments (BoP), Fundamentals of BoP, Accounting components of BOP, Factors affecting International Trade flows, Agencies that facilitate International flows. Case study.

UNIT - III: International Monetary System & Asset-Liability Management

Evolution, Gold Standard, Bretton Woods system, the flexible exchange rate regime, evaluation off loating rates, the current exchange rate arrangements, the Economic and Monetary Union(EMU); Foreign Direct Investment, International Capital Budgeting, International Cash management, Case study.

UNIT - IV: Foreign Exchange Market

Function and Structure of the Forex markets, major participants, types of transactions and settlements dates, Foreign exchange quotations, process of arbitrage, speculation in the forward market; Overview of the other markets–Euro currency market, Euro credit market, Euro bond market, International Stock market; Case study.

UNIT- V: Exchange Rates

Measuring exchange rate movements, Factors influencing exchange rates. Government influence on exchange rates–exchange rate systems. Managing Foreign exchange Risk. International arbitrage and interest rate parity. Purchasing Power Parity–International Fisher Effect–Fisher Effect; Case study.

Text Books

1. Alan C.Shapiro, Multinational Financial Management, 10/e, John Wiley, 2013.
2. Jeff Madura, International Corporate Management, 11th edition, Thomson Publications, 2011.

Reference Books

1. Dr. Pradeep Kumar Sinha, International Financial Management, Himalaya Publishing House,2015
2. P.K Jain, Josette Peyrard and Surendra S. Yadav, International Financial Management, Macmillan Publishers, 2006.
3. P.G.Apte,InternationalFinancialManagement,5/e Tata McGraw Hill, New Delhi, 2009.
4. Madhu Vij, International Financial Management, second edition, Excel Books, 2005.
5. V. A. Avadhani, International Financial Management, Himalaya Publishing House, Hyderabad, 2009.

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HR ANALYTICS

III - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand and improve the value of the Human resource
- To familiarize the use and application of workforce analytics, to maximize return on human capital.
- To identify HR bench marks and metrics relevant to organizational goals.

Course Outcomes

Upon successful completion of the course, students will be able to

- understand the various concepts and approaches of HR analytics
- analyse leadership practices and HR intelligence cycles in the organisation.
- compare recruiting tools of staffing metrics.
- determine various metrics of training and Performance management.
- conversant with the aspects of how to measure compensation as well as cost benefit analysis.

UNIT - I: Introduction to HR Analytics

Meaning of HR analytics, Definition of analytics, Need for HR Analytics, Leading Practices for Improved Organizational Performance, Contribution of HR Analytics, Approaches to HR Analytics, Human Resources analytics applications, Role of HR in building organizational capabilities - Case Study.

UNIT - II: HR intelligence Framework

Human Capital Maturity Framework- leadership practices; engagement practices; access to knowledge practices. People research & analytics practices; HR intelligence cycle; Organizational Intelligence Model (OIM); HR intelligence implementation, HR Scorecard; Workforce Scorecard; constructing HR scorecard - Case Study.

UNIT - III: Staffing Metrics

Recruiting tools and practices an overview, measure the quality of hire, measuring the quality of applicants. Measuring the costs of hiring. Recruitment Analytics and On Boarding Analytics Staffing Analytics Performance & Skill Gap Analytics Attrition metrics – techniques used to calculate attrition, manpower planning metrics – push and pull model - Case Study.

UNIT - IV: Development Metrics

Training ROI, Training evaluation models, tracking the value of career management, measurement, performance metrics, EFQM, and Baldridge criteria, The Intuitive, non-analytic framework for Performance Management; The Targeted Analytics to improve Talent Decisions - Case Study.

UNIT - V: Compensation Metrics

Calculating various wage/salary related measures. Variable pay systems, types of executive compensation, quantitative application in compensation – percentiles, cost benefit analysis, and comp ratios. Mistakes in compensation designing. Employee benefits, Calculation of incentives, measuring the impact of weak incentives. Monitoring planned and unexpected absence, the cost impact of unplanned absences and staffing - Case Study.

Text Books

1. Swati Dhir, Suparna Pal, Human Resource Analytics: Theory and Application Techniques, Cengage India, 2020.
2. Dipak Kumar Bhattacharyya HR Analytics- Understanding Theories and Applications, SAGE Publications,2017.
3. Edwards Martin R, Edwards Kirsten (2016), ¯Predictive HR Analytics: Mastering the HR Metric , Kogan Page Publishers, ISBN-0749473924.
4. Subhashini Chellappan Seema Acharya, Big Data and Analytics, Wiley, 2019.

Reference Books

1. Fitz-Enz, J. (2001). How to Measure Human Resource Management, McGraw-Hill; 3edition.
2. Bernard Marr (2018), Data Driven HR: How to use Analytics and metrics to data driven performance, Kindle Edition.
3. Fitz-Enz, J. (2009). The ROI of Human Capital: Measuring the Economic Value of Employee Performance, AMACOM; Second Edition.
4. Fitz-Enz. J & John R. Mattox, II (2014), Predictive Analytics for Human Resources, John Wiley & Sons, Inc., Hoboken, New Jersey.

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Specialisation - HR

INDUSTRIAL RELATIONS AND LABOUR LAWS

III - Semester

Lecture	: 4		Internal Marks	: 30
Credits	: 3		External Marks	: 70

Course Objectives

- To acquainting the students with the essentials of Industrial Relations in India.
- To familiarizing them with the use of preventive measures in IR
- To helping them to know specific provisions under various laws

Course Outcomes

Upon successful completion of the course, students will be able to

- understand the evolution and concept of Industrial Relations and Trade Unions in India.
- design Grievance handling Procedure for settling employee grievances and industrial disputes.
- understand a perspective of labour problems and remedial measures in the country.
- conversant with the legal aspects of how to deal with social security measures as well as working conditions of factories.
- conversant with the legal aspects of how to deal with employee welfare measures as well as employee wages.

UNIT - I: Introduction to Industrial Relations

Industrial Relations Perspective: Concept, importance, scope and aspects of industrial relations, causes and effects of poor industrial relations in India. Approaches to industrial relations, Trade Unions - Trade Union Act, 1926; Historical evolution of trade unions in India, role and functions of trade unions, essentials for success of trade unions - Case Study.

UNIT - II: Grievance Management and Industrial Disputes

Employee Discipline - causes of discipline, kinds of punishment, Grievance Procedure - settlement of grievance, model grievance procedure, collective bargaining. Industrial disputes - Industrial Disputes Act, 1947, causes and methods for settlement of industrial disputes - Case Study.

UNIT - III: Labour Welfare, Social Security and Workers' Participation in Management (WPM)

Introduction - history of labour welfare, theories of labour welfare; Labour Welfare

Officer – role, functions and duties. Employees' Safety and Social Security-health and occupational safety programs; Workers' Participation in Management in India – shop floor, plant and corporate level- case study.

UNIT - IV: Legal Framework for Social Security

Employees Compensation act, 1923; Employees State Insurance Act, 1948; Employees Provident Fund and Miscellaneous Provisions Act, 1952; Payment of Gratuity Act, 1972; Maternity Benefit Act, 1961-case Study.

UNIT - V: Laws Related to Employee Welfare and Wages

Industrial Employment (Standing Orders) Act, 1946; Factories Act, 1948; Contract Labour Act, 1970; Payment of Wages Act, 1936; Minimum Wages Act, 1948; Payment of Bonus Act, 1965 -Case Study.

Text Books

1. Gupta, P. *Industrial Relations and Labour Laws for Managers*. SAGE Publications,(2019).
2. Sen, R. *Industrial Relations: Text and Cases*. Macmillan Publishers India Limited, (2014).
3. Sinha, I. B, Industrial Relations, Trade Unions, and Labour Legislation: India: Pearson Education India, (2017).

Reference Books

1. Industrial Relations, Trade Unions and Labour Legislation, Pearson India, 2017.
2. Ravindranath, E. I. Industrial Relations in India: A Practitioner's Handbook. India: McGraw Hill Education (India), 2013.
3. Monappa, Industrial Relations and Labour Laws. (n. d.). (n. p.): Tata McGraw-Hill Education, 2012.

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Specialisation - Marketing

MARKETING OF SERVICES

IV - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand insights into emerging trends in the service sector
- To explain the unique challenges involved in marketing and managing services
- To acquaint the role of service recovery and relationship marketing in marketing of services.

Course Outcomes

Upon successful completion of the course, students will be able to

- appraise the emergence of service economy, characteristics of services and dealing with the extended services marketing mix
- understand customers' purchasing and consumption behavior to develop strategies for relationship marketing
- assess the difference between marketing physical products and intangible services to develop strategies for service physical evidence and managing employees for service organisation
- design and develop quality service product and service recovery strategies
- deal the decisions related to pricing, promotion and distribution of service products.

UNIT - I: Introduction to Marketing of Services

Service–Characteristics and Classification. Services in the Modern Economy- Role of Services in Indian Economy. Marketing of Services Vs. Goods, Product Service Continuum, Services Marketing Challenges, Service Marketing Mix. Service Marketing Triangle - Case Study.

UNIT - II: Consumer Behaviour and Relationship Marketing

Consumer Behaviour in Services-Understanding Customer Needs and Expectations, Service Perceptions, Service Encounters. Relationship Marketing- Relationship Development Strategies and Challenges - Case Study.

UNIT - III: Service Development and Physical Evidence

Service Development- Planning, Creating and Branding Service Products, New Service Development; Service Blueprinting, Service Process Redesign; Service Physical Evidence, Service scape, Physical Evidence Strategy; Role of Employees and Customers in Service Delivery. - Case Study

UNIT - IV: Service Quality and Recovery

Service Quality - Service Quality Dimensions, Gaps model of Service Quality. Service Recovery – Customer Responses to Service Failures, Customer Recovery Expectations, Complaint Handling, Recovery management, Recovery Strategies; Service Recovery Effects; Service Guarantees - Case Study.

UNIT - V: Services Pricing, Promotion and Distribution

Pricing of Service - Establishing Pricing Objectives, Pricing Related to Four Value Definitions; Service Communication- Challenges, Communication Mix. Service Delivery Process-Delivering Services through Intermediaries and Electronic Channels, Balancing Demand and Capacity in service delivery - Case Study.

Text books

1. Valarie A Zeithaml, D D Gremler et. al., Services Marketing, 4th edition, TMH, New Delhi.
2. Rajendra Nargundkar: Services Marketing, 3rd edition, TMH, New Delhi.
3. R Srinaivasan, Services Marketing, Indian Context, 4th edition, Prentice Hall of India, New Delhi.
4. Harsh V.Verma: Servcies Marketing, 2nd edition, Pearson Education, New Delhi.

Reference Books

1. Christopher Lovelock, Jayanta Chatterjee and Jochen Wirtz, Services Marketing: People, Technology, Strategy, Pearson Education, 7th edition.
2. Govind Apte: Services Marketing, Oxford University Press, New Delhi,2009
3. Ravi Shanker: Services Marketing, Excel Books, New Delhi, 2010
4. Christian Gronroos: Service Management and Marketing, Wiley India, New Delhi, 2010
5. Vasanthi Venugopal: Services Marketing, Himalaya Publishing House, 2010
6. Nimith Chowdhary: Marketing of Services, MacMillan Publishers, New Delhi, 2009.
7. Douglas Hoffman K: Marketing of Services, Cengage learning, New Delhi 2010.

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Specialisation - Marketing

SALES AND DISTRIBUTION MANAGEMENT

IV - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To develop understanding and appreciation of the Sales & Distribution processes in organizations.
- To Estimate the role of variables in sales force motivation and distribution channel management.
- To Plan and implement an effective sales strategy for their organizations

Course Outcomes

Upon successful completion of the course, students will be able to

- understand the concepts of personal selling and functions of sales management.
- apply the knowledge of various concepts of sales potential analysis which are helpful in developing sales quota and managing sales territory.
- evaluate the tools and strategies necessary for selecting, training and evaluating sales force.
- execute the strategies related to selecting and managing distribution channels.
- identify conflicts in distribution channel and manage channel efficiently.

UNIT - I: Sales Management

Objectives and functions of sales management, selling as a Career, Sales
Organisation, Purpose of setting up a sales organisation, Types of Sales Organi-
zations, Organisation of the sales department, inter department relations, Ethics
in Sales management. Process of Personal Selling - Case Study.

UNIT - II: Sales Potential Analysis and Territory Management

Sales Potential – Sales Volume – Sales Quotas. Sales Forecasting – Different
methods of sales forecasting. Sales Budgets, Sales Territory – Reasons for es-
tablishing sales territories, Time and Territory Management; Routing and sched-
uling sales personnel - Case Study.

UNIT - III: Sales Force Management

Recruitment , Selection and Training of Sales personnel , selecting training meth-
ods, evaluating sales training programmes – Motivation and Compensation Plans
of sales force – Evaluation of Salesmen's Performance – Sales Control Research

- Case Study.

UNIT - IV: Channels of Distribution

Origins, evolution & uniqueness of the Indian distribution environment, Channel Structure and Functions, Channel Design Process and channel management decisions–Selecting Channel Members Motivating Channel Members, Customer service and physical distribution - Case Study.

UNIT - V: Channel Management

Role and types of Channel intermediaries, Channel conflicts – Reasons – Managing Channel Conflicts Evaluating Channel Member Performance – Retail Management, Impact of IT on Physical Distribution, Emerging trends in Distribution Management - Case Study.

Text Books

1. Richard R. Stire, Edward W. Candiff and Norman, A.P. Gavani, Sales Management Decisions, Policies and Cases – Prentice Hall.
2. Tapan K Panda: Sales and Distribution Management, Oxford University Press, New Delhi, 2019.
3. Krishna K Havaldar, Vasant M Cavale, Sales and Distribution Management, TMH, New Delhi, 2011
4. S.L. Gupta, Sales and Distribution Management: Text and Cases, Excel Publishers.
5. Pingali Venugopal, Sales and Distribution Management: An Indian Perspective, Response Books, New Delhi.

Reference Books

1. Tony Carter: Sales Force Management, Jaico Publishing House, New Delhi, 2008.
2. S.A. Chunawala: Sales and Distribution Management, Himalaya Publishing House, New Delhi, 2009.
3. Aftab Alam Sales and Distribution Management, Wisdom Publication.
4. Eugene. M. Johnson, David L. Kurty and Enirhard. E. Scheuing – Sales Management, Concepts, Practices and Cases by Mc Graw Hill International.
5. Berg Rosen bloom – Marketing Channels – a Management View – by the Dryden Press, Hinsdale, Illinois.
6. Aune T. Coughlan, Stern E. Ansary – Marketing Channels, Prentice Hall of India.
7. Matin Khan: Sales and Distribution Management, Excel Publish.
8. Hair, Anderson: Sales Management, Cengage Learning, New Delhi, 2010.
9. Mark W Johnston: Sales Force Management, TMH, New Delhi, 2009.

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Specialisation - Finance

FINANCIAL DERIVATIES

IV - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To Understand the students about the concept of Derivatives and its types
- To acquaint the knowledge of Options and Futures and
- To know about Hedging and the development position of Derivatives in India.

Course Outcomes

Upon successful completion of the course, students will be able to

- analyse and evaluate the characteristics of financial derivative instruments.
- understand the futures and option strategies.
- learn valuation, analysis and application for hedging, speculation and arbitrage for financial derivatives.
- learn the mechanics, valuation and trading strategies of derivative market.
- develop a trading strategy in the volatile market.

UNIT - I: Introduction to Derivaties

Development and growth of derivative markets, types of derivatives uses of derivatives, fundamental linkages between spot & derivative markets, the role of derivatives market, uses and misuses of derivatives.

UNIT - II: Future and Forward Market

Structure of forward and future markets, mechanics of future markets hedging strategies, using futures, determination of forward and future prices, interest rate futures currency futures and forwards-- Case study

UNIT - III: Options

Distinguish between options and futures, structure of options market, principles of option pricing, option pricing models: The binomial model, the black – scholars Merton model. Trading Strategies: strategies involving options - spread, combinations, other payoffs -options on indices - hedging strategies using derivatives-Case study.

UNIT - IV: Commodity Market Derivaties

Introduction, types, commodity futures and options, swaps commodity exchanges multi commodity exchange, national commodity derivative exchange role, functions and trading.

UNIT - V: Swaps

Features of swaps, major types of swaps, interest rate swaps, currency swaps, commodity swaps, equity index swaps, credit risk in swaps, credit swaps, using swaps to manage risk, pricing and valuing swaps - Case study.

Text Books

1. S.L. Gupta, Financial Derivatives, PHI Learning Pvt. Ltd,2017.
2. Prakash B Yarogal, Financial Derivatives, Vikas Publication,2018.
3. McDonald, Derivatives Markets, Perason, 2015.

Reference Books

1. John Hull, Options, Futures and other Derivatives, Pearson Education.
2. Jayanth Rama Varma Derivatives and Risk Management, TMH, 2017.

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Specialisation - Finance

FINANCIAL INSTITUTIONS AND SERVICES

IV - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the aspects of economics those are most relevant for a career in banking and finance.
- To provide knowledge on different types of banking and financial systems in emerging countries.
- To evaluate the financial services offered by different companies.

Course Outcomes

Upon successful completion of the course, students will be able to

- understand the role and function of the financial system in reference to the macro economy.
- analyze differentiated markets and generalize the importance of major and minor markets in Indian industry with SEBI regulations.
- understand the nature of financial intermediation and regulations carried out by the both Banking and Non – banking institutions.
- know the various types of insurance and insurance business in India.
- differentiate between fund and fee based financial services.

UNIT - I: The Basic Theoretical Framework

The financial system and its technology; the factors, financial intermediaries and Financial Innovation; RBI-Central Banking - Case Study.

UNIT - II: Financial Institutions & Instruments

An update on the performance of IDBI, ICICI, IFCI and SFCs. Role and structure of money market and capital market–Call money market, Treasury bill market, and Commercial bill market including commercial paper and certificate of deposits, Discount market–Government securities market–Primary and secondary market for securities, Book Building Mechanism - Case Study.

UNIT - III: Banking & Non- Banking Institutions

Commercial banks–the public and the private sectors–structure and comparative performance. The problems of competition; interest rates, spreads, and NPAs. Bank capital–adequacy norms and capital market support; Non-Banking Institutions: Evolution, control by RBI and SEBI. Unit Trust of India and Mutual Funds - Case Study.

UNIT - IV: Insurance

Concept of Insurance, Need for Insurance, Insurance Industry in India, Role of IRDA, Principles and Benefits of Insurance, Reinsurance, General insurance and its types, Life insurance and its types - Case Study.

UNIT - V: Financial Services

Asset/fund based Financial services – lease finance, consumer credit and hire purchase finance, factoring definition, functions, simple problems on factoring, bills discounting, housing finance, venture capital financing. Fee-based / Advisory services: Stock broking, credit rating, bankers to an issue, debenture trustees, portfolio managers - Case Study.

Text Books

1. R.Shanmugham: Financial Services, Wiley India, New Delhi, 2010.
2. M.Y.Khan, Financial Services, Tata McGraw Hill, New Delhi, 2004.
3. LM Bhole & Jithendra Mahakud: Financial Institutions and Markets, TMH, NewDelhi,2009.
4. P.K. Gupta: Insurance & Risk Management, Himalaya Publishing House: Mumbai.

Reference Books

1. Meir Kohn: Financial Institutions and Markets, Oxford University Press, New Delhi,2009.
2. Sames L .Heskett, managing in the Service Economy, Harvard Business School Press, Boston, 2001.
3. Bharti V Pathak: The Indian Financial System, Pearson Education, New Delhi, 2010.
4. H.R Machiraju, Indian Financial Systems, Vikas Publishing House Pvt. Ltd.2002.
5. Clifford Gomez: Financial Markets, Institutions and Financial Services, PHI Learning,NewDelhi2009
6. George E. Rejda: Principles of Risk Management & Insurance, Pearson: New Delhi.

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Specialisation - HR

COMPENSATION MANAGEMENT

IV - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the various dimensions of Compensation Management.
- To determine factors involved in payrolls calculation.
- To evaluate various theories involved in wage and salary administration.

Course Outcomes

Upon successful completion of the course, students will be able to

- learn basic compensation concepts, components and Wage theories.
- develop an understanding of various types of wage methods and Incentive plans that helps improving the quality of production.
- analyze, integrate, and apply the knowledge of Payroll Management to solve compensation related problems in an organization.
- know the role of Collective bargaining in wage determination.
- understand various pay commissions in India.

UNIT - I: Compensation Management

Conceptual Frame work of Compensation Management: Concept and Components of Wages, Theories of wages: Subsistence theory, Wage Fund Theory, Marginal Productivity theory, Residual claimant theory, Bargaining theory, Criteria of wage fixation. Executive compensation, emerging trends of compensation management in IT industries - Case Study.

UNIT - II: Wage Determination

Principles of wage and salary administration, Job Evaluation: Concept, Scope, Methods and techniques, Performance based pay systems; Knowledge based pay system, market based pay system, Incentive based pay system, Types of incentive plans, Wage differentials - Case Study.

UNIT - III: Wage Administration in India

Wage Policy in India, Methods of wage determination in India, Role of Collective bargaining in wage determination, The Minimum Wages Act - Case Study.

UNIT - IV: Benefit Programs

Wage Boards–Pay Commissions–Compensation Management in Multi-National organizations - Case Study.

UNIT - V: Payroll

Salary Calculation - Income tax Calculations - PF and Gratuity-Bonus, Ex-Gratia, Incentive, Superannuation103 - Case Study.

Text Books

1. R C Sharma, Sulabh Sharma, Compensation Management, SAGE Publisher, 2019.
2. Deb Tapamoy, Compensation Management: Text and Cases, Excel books, 2010.
3. M S Bhattachrya, Compensation Management, Excel books, 2009.
4. Richard.I.Henderson: Compensation Management In A Knowledge Based World –Prentice-Hall, 2007.

Reference Books

1. Thomas. P. Plannery, David.A. Hofrichter & Paul E. Platten: People Performance&Pay–FreePress.2002
2. Michael Armstrong & Helen Murlis: Hand Book of Reward Management–Crust Publishing House, 2004.

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Specialisation - HR

MANAGEMENT OF CHANGE AND DEVELOPMENT

IV - Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To develop insight and competence in diagnostic and intervention processes and skills for initiating and facilitating change in organizations.
- To Gain necessary self-insight, skills and techniques to become effective change agents and internal OD consultants.
- To familiarize with various dimensions of culture in managing change.

Course Outcomes

Upon successful completion of the course, students will be able to

- explore conceptual, theoretical and practical perspectives on change management.
- assess the impacts of change, to develop effective change teams and to recognise and address resistance to change
- identify key drivers of an organization's culture and its implications.
- appreciate the process of organisational development and OD interventions
- outline important aspects of how to build and equip a change team to improve organisational effectiveness.

UNIT - I: Basics of Change Management

Introduction to change, stimulating forces, planned change, change agents, un-planned change, model of organisational change – Lewin's three step model - Case Study.

UNIT - II: Resistance to Change

Change management process, phases of the change management process, con-cept of resistance to change, forms of resistance, reactions to change, resis-tance to organizational change Initiatives, overcoming the resistance to change, techniques to overcome resistance - Case Study.

UNIT - III: Concept of Organizational Culture

Dimensions of culture, type of culture, assessing organizational culture, role of culture in managing change, approaches to individual change, and implications of change in individuals - Case Study.

UNIT - IV: Organization Development (OD)

Meaning, nature and scope of OD, dynamics of planned change, person-focused and role-focused OD interventions, planning OD Strategy – OD interventions in Indian organizations, challenges to OD - Case Study.

UNIT - V: Team Building

Nature and importance of teams, team Vs groups, types of teams, characteristics of virtual teams, team building life cycle, role of managers as linking pins, team building skills, virtual teams, high performance teams, self managing teams building team relationships, empowered teams - Case Study.

Text books

1. Ratan Raina "Change Management and Organizational Development" SAGE Publications 2019.
2. Mark Hughes: Managing and Leading Organizational Change", Routledge publication 2018.
3. Kavitha Seth, "Organization Change and Development", Excel Books, 2014
4. Robert A Paton: "Change Management", Sage Publications, New Delhi, 3rd edition, 2008.

Reference Books

1. Nilanjan Sengupta: Managing Changing Organisations, PHI Learning, New Delhi, 2016.
2. Cummings: "Theory of Organisation Development and Change", Cengage Learning, New Delhi, 1st edition, 2013.
3. Radha R. Sharma, "Change Management", Tata McGraw Hill, New Delhi, 2012.

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