DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction
and
Syllabi of

B.E. VII & VIII Semesters

2021-2022

AICTE MODEL CURRICULUM

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

OSMANIA UNIVERSITY

HYDERABAD – 500 007 TELANGANA

SCHEME OF INSTRUCTION
B.E. (ECE), VII – SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1	PC 701EC	Microwave Techniques	3	1	0	3	30	70	3
2	**Professional Elective-IV**		3	0	0	3	30	70	3
	PE 741EC	SOC Design							
	PE 742EC	Satellite Communications							
	PE 743EC	Artificial Intelligence and Machine Learning							
	PE 744EC	Fault Detection in Digital Systems							
3	**Professional Elective-V**		3	0	0	3	30	70	3
	PE 751EC	Optical Communications							
	PE 752EC	Low Power VLSI Design							
	PE 753EC	Internet of Things							
	PE 754EC	RF Circuit Design							
4	OE #	Open Elective-II	3	0	0	3	30	70	3
5	HS 701ME	Industrial and Financial Management (**Only for ECE**)	3	0	0	3	30	70	3
Practicals									
6	PC 751EC	Microwave Laboratory	0	0	2	2	25	50	1
7	PW 751EC	Major Project Phase -I	0	0	4	4	50	0	2
8	PW 752EC	Self-Study Project	0	0	0	4	50	0	2
9	PW 961EC	Summer Internship*	6-weeks				50	0	0
Total			**15**	**1**	**6**	**25**	**325**	**400**	**20**

*Students have to undergo summer internship of 6 Weeks duration at the end of semester VI and Evaluation will be done in VII - Semesters.

L : Lectures	**Open Elective-II**
T : Tutorials	1. OE701BM Micro Electro-Mechanical Systems
P : Practicals	2. OE702CE Green Building Technology
CIE : Continuous Internal Evaluation	3. OE703CS Information Security
SEE : Semester End Examination	4. OE704CS Data Base Management Systems
PC : Professional Core	5. OE705EC Embedded Systems
PE : Professional Elective	6. OE706EC Verilog HDL
OE : Open Elective	7. OE707EC Satellite Communication and Applications
HS : Humanities and Social Sciences	8. OE708EE Optimization Techniques
PW : Project Work	9. OE709EE Non-Conventional Energy Sources
	10. OE710ME Start-up Entrepreneurship
	11. OE711ME Nano Technology

PC 701EC

MICROWAVE TECHNIQUES

(Professional Core)

Instruction: (3L+1T) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To learn field calculations between parallel planes and rectangular wave guide.
- To study and understand various microwave devices and circuits.
- To study the construction and to understand principal of amplification/Oscillation at microwave frequency.

Course Outcomes: Student will be

1. Able to understand electromagnetic wave propagation in parallel plane waveguides.
2. Able to understand electromagnetic wave propagation in rectangular waveguides and resonators.
3. Able to understand the formulation of Scattering Matrix and define them for various microwave components.
4. Able to learn principle of operation and applications of specialized microwave vacuum tubes.
5. Able to distinguish between transfer electron devices from ordinary low frequency semiconductor devices and learn basic modes of operation of Gunn Diode and its applications.

UNIT – I

Waves between parallel planes, TE, TM, TEM Waves characteristics, Velocity of propagation, Group and Phase velocity, Wave Impedance, Attenuation in parallel plate guides.

UNIT – II

TE & TM Waves in rectangular wave guides, Wave impedance, Attenuation and Q of Waveguides, Waveguide resonators, Power handling capability, Transmission line analogy, Waveguide Design/Bandwidth.

UNIT – III

Microwave circuit concepts, Normalized voltage and current, scattering parameters, properties of S-Matrix, Unitary property. S-Matrix for directional coupler, Magic tee, Construction, principle and applications of Attenuator, Phase Shifter, Circulator, Isolator, S-Matrix of Circulator.

UNIT – IV

High Frequency limitations of conventional tubes, Two cavity Klystron, Bunching by velocity modulation, Small signal theory of bunching, Effect of grid interception and de-bunching. Tran's admittance, Reflex Klystron, Mathematical theory of bunching, Admittance spiral and condition of oscillation. Principle of operation, construction and characteristics of TWT Amplifier, Backward wave oscillator (qualitative treatment only).

UNIT – V

Principle of operation, construction and characteristics of multi-cavity magnetron, Microwave Solid-state devices: Introduction, Classification and Applications. TEDs —Introduction, Gunn Diode — Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes, Introduction to Avalanche Transit-Time Devices.

Suggested Readings:

1. Samuel Y. Liao, "*Microwave Devices and Circuits"*, 3rd Edition, PHI, 1994.
2. Pozar D.M., "*Microwave Engineering*", 3rd edition, John Wiley & Sons, 2005.
3. Skalnik, Krauss, Reich, "*Microwave principles"*, East West Press, 1976.

PE 741EC

SOC DESIGN

(Professional Elective - IV)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To Understand the System Architecture and Processor Architecture, approach for a SOC Design and the concept of pipelining.
- To Learn about SOC external memory, Scratchpads and Cache memory and Multilevel Caches.
- To familiarize with on-chip memory concepts for SoC and to adopt the architectural support for operating systems.

Course Outcomes: Students will be able to**:**

1. Analyze the system and processor architecture approach for SoC design
2. Explore the concept of pipelining.
3. Understand the concept of memory interface and bus architecture for SoC design.
4. Analyze the performance metrics of on-chip memory.
5. Understand the architectural support for operating systems.

UNIT – I

Introduction to System on Chip: System Architecture components of the system, hardware and Software, processor architecture, memory and addressing, system level interconnection, an Approach for SOC design, system architecture and complexity.

Processor design: Processor architecture and organization, processor design trade-offs, the Reduced instruction set computer, the acron risc machine, architectural inheritance, the arm Programmers model, arm development tools.

UNIT – II

Organization of an SoC: 3-stage pipeline arm organization, 5-stage pipeline arm organization, the arm coprocessor interface coprocessor instructions, data operations, data transfers, the thumb bit in the cpsr, the thumb programmer's model

UNIT – III

Architectural support for system development: The arm memory interface, the advanced micro controller bus architecture (amba), the arm reference peripheral specification, hardware system prototyping tools, the armulator, the jtag boundary scan test architecture embedded trace, signal processing support.

UNIT – IV

Memory hierarchy: Memory size and speed: memory cost, on chip memory, caches: processor & Memory speeds, unified & Harvard caches, cache performance metrics, the direct mapped Cache the set-associative cache, the fully associative cache, write strategies cache design-an example.

UNIT – V

Architectural support for operating systems: An introduction to operating system, the arm System control coprocessor, cp15 protection unit register, arm protection unit, cp15 mmu Registers, arm mmu architecture, synchronization, context switching, input/ouput.

Suggested readings:

1. Steve furber, *"arm system-on-chip architecture"*, second edition, pearson publications
2. Andrew n.sloss, domnic symes,chris wright, *"arm system developers guide"*, publications Elsevier.

PE 742EC

SATELLITE COMMUNICATION

(Professional Elective - IV)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To familiarize with basic concepts related to satellite Communication.
- To understand Sub-Systems of Satellites and Launches.
- To design the Earth Station antennas.
- To know about the parameters affecting the Satellite System Performance.
- To understand the applications of satellites.

Course Outcomes: Student will be,

1. Able to have knowledge about the Satellite communications Principles and Properties.
2. Able to know about the Space craft subsystems and Launch vehicles.
3. Able to design the Satellite Earth station antennas
4. Able to analyze the effects of various parameters on Satellite System performance.
5. Able to understand the applications of Satellite Communication.

UNIT–I

Origin of Satellite communications, A Brief History of Satellite Communication, Basic principles and properties of satellite communication. Earth segment, Space segment, Interpretation of Kepler's Laws. Orbital Mechanics: The Equation of the Orbit, Describing the Orbit, Locating the Satellite in the Orbit, Orbital effects in communication system Performance: Doppler shift, Range variation, Eclipse and Sun-Transit Outage.

UNIT– II

Space craft sub systems, Equipment Reliability and Space Qualification: Space Qualification, Reliability, and Redundancy, Satellite launch and launch vehicles and Mechanics of Launching a Synchronous Satellite.

UNIT– III

Earth Stations: Earth Station Design for Low System Noise Temperature, Design of large antennas and small earth station antennas. Low noise amplifiers and High power Amplifiers for Satellite communication.

UNIT– IV

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T ratio: Noise Temperature, calculation of System Noise Temperature, Noise Figure and Noise Temperature, Propagation on Satellite-Earth paths: Attenuation, depolarization, atmospheric absorption, Tropospheric Multipath effects and Land and Sea Multipath, Multipath Effects in System Design,Faraday rotation in the Ionosphere, Ionospheric scintillations, Rain and ice effects.

UNIT– V

Satellite Navigation Applications: Global and Regional Satellite Navigation Systems- Operating Principles, Advantages, Limitations, Current Status and Applications, Remote Sensing Satellites

Suggested Readings:

1. Wilbur L. Pitchand and Henri G. Suyderhoud, Robert A. Nelson, "*Satellite Communication Systems Engineering"*, 2nd edn. 3rd Impression, Pearson Education.2008.
2. Timothy Pratt and Charles Nestian. W, "*Satellite Communication"*, John Wiley and Sons, 1988.
3. Tri T. Ha, "*Digital Satellite Communication"*, Tata McGraw- Hill, Special Indian Edition2009.

PE 743EC

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(Professional Elective - IV)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.

Course Outcomes: At the end of the course, the student should be able,

1. To identify problems that are amenable to solution by AI methods.
2. To identify appropriate AI methods to solve a given problem & implement basic AI algorithms
3. To formalize a given problem in the language/framework of different AI methods.
4. To study the basics of Machine learning. Usage of Python packages for Machine Learning
5. To evaluate the performance of various Machine Learning algorithms on a dataset

UNIT - I
INTRODUCTION TO Al AND PRODUCTION SYSTEMS
Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies' Search strategies. Problem characteristics, Production system characteristics - Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

UNIT - II
REPRESENTATION OF KNOWLEDGE
Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT - III
ADABOOST
Concept of ensemble of classifiers; basic algorithm; case study- Face detection Artificial Immune Systems Fuzzy belief networks, Evolving belief networks Bayesian belief networks Evolutionary and swarm-based neural networks.

UNIT - IV
MACHINE LEARNING
Classification, Machine learning: clustering, Machine learning: classification. Logistic regression Bayesian logistic regression Non-linear logistic regression Dual logistic regression Kernel logistic regression, Incremental fitting and boosting.

UNIT - V

REINFORCEMENT LEARNING

Classification trees- Multi-class logistic regression Random trees, Random forests, Applications. Introduction to Deep Learning.

Suggested readings:

1. Kevin Night and Elaine Rich, Nair B., *"Artificial Intelligence (SIE)"*, Mc Graw Hill-2008. (Units-I,II,VI & V)
2. Dan W. Patterson, *"Introduction to AI and ES",* Pearson Education, 2007. (Unit-III).
3. Peter Jackson, *"Introduction to Expert Systems"*, 3rd Edition, Pearson Education, 2007.
4. Stuart Russel and Peter Norvig *"AI – A Modern Approach"*, 2nd Edition, Pearson Education 2007.
5. Deepak Khemani *"Artificial Intelligence",* Tata Mc Graw Hill Education 2013.
6. http://nptel.ac.in

PE 744EC

FAULT DETECTION IN DIGITAL SYSTEMS

(Professional Elective - IV)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To represent physical faults by logical faults and understand fault modeling methods.
- To understand methods for economical fault detection test experiments.
- To be able to generate tests for fault detection in sequential circuits.
- To understand the usage of coding techniques to generate test patterns for self-checking circuits.
- To address the problem of test generation for SSFs using TG algorithms.

Course Outcomes: Student will be

1. Able to understand various design and modeling concepts thoroughly.
2. Able to device test inputs using various methods and compare the complexity of the techniques qualitatively.
3. Able to design detection test sets for sequential circuits.
4. Able to understand the usage of self-checking codes for fault detection.
5. Able to understand various algorithms and compare their implementation costs qualitatively.

UNIT – I

Introduction: Modeling and testing digital circuits at different levels of abstraction, Types of testing, Errors and Faults, Fault classification and modeling, Hazards, Test generation and evaluation.

UNIT – II

Fault detection in Combinational Circuits: Detection of single stuck faults using Fault Table method, path sensitization and Boolean difference method, fault detection in two level and multilevel circuits, Bridging fault model, detection of non-feedback and feedback bridging faults, bridging fault simulation and test generation.

UNIT – III

Fault Detection in Sequential Circuits: State identification with homing and distinguishing experiments, Design of fault detection experiments for diagnosable machines.

UNIT – IV

Self-Checking Design: Basic concepts, application of Error-detecting and Error-correcting codes, multiple bit errors, checking circuits and self-checking, self-checking checkers, parity-check functions, totally self-checking m/n code checkers, totally self-checking equality checkers, self-checking Berger code checkers.

UNIT – V

Test Generation algorithms for SSFs: Combinational Circuits-Fault oriented ATG- algorithms and selection criteria, fault independent ATG, ATG for sequential circuits using iterative array model.

Suggested Readings:

1. Samuel C Lee, "*Digital Circuits and Logic Design*". PHI Pvt. Ltd. 2000
2. Zvi Kohavi, "Switching *and Finite Automata Theory*", TMH.2nd edition
3. M. Abramovici, M. Breuer, A. Friedman, "Digital *System Testing and testable design*", Jaico Publications

PE 751EC

OPTICAL COMMUNICATIONS

(Professional Elective - V)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To become familiar with the fundamental concepts of Light, Basic laws of light, various types of Optical fibers, modes and configurations.
- To acquaint with theoretical analysis of the Signal propagation and distortion during propagation of light in Optical Fibers.
- To become familiar with Optical sources, Optical detectors and Optical amplifiers
- To understand the design principles of Digital and Analog links
- To know the operating principles of WDM and components for its realization

Course Outcomes: Student will be

1. Able to apply Optical Laws to provide solutions to the problems of Optical Waveguides
2. Able to deal with the Optical Communication System designs.
3. Able to carry out the calculations of various noise powers at Optical Receivers
4. Able to design the Optical Link Power Budget and Rise Time Budget for the given applications
5. Able to design the WDM systems with various system considerations

UNIT – I

Overview of Optical Fiber Communications: The evolution of optical fiber systems, Elements of an Optical fiber transmission link, Optical fibers, Nature of light – basic optical laws and definitions – Modes and configurations, Mode of theory of circular waveguides, Single and multi- mode step index and graded index fibers.

UNIT – II

Signal degradation in Optical fibers: Attenuation, Signal distortion in optical waveguides, Mode coupling, and Design optimization of single mode fibers.

Optical sources: Semiconductors as optical sources and their fabrication, LED's and Laser diodes, Linearity of sources, Modal, partition and reflection noise

UNIT – III

Photo detectors: Physical principles of PIN and APD, Photo detector noise, Detector response time, Avalanche multiplication noise, Temperature effect on Avalanche gain, Comparisons of Photo detectors.

Optical receiver operation: Fundamental receiver operation, Digital receiver performance calculation. Preamplifiers types, Analog receivers

UNIT – IV

Point-to-Point Optical links: System considerations, Link power budget, Rise time budget, Noise effects on system performance. Overview of analog links, Carrier noise ratio in analog systems

UNIT – V

Optical Amplifiers & WDM: Introduction to optical amplifiers, Basic applications and types of Optical amplifier, WDM concepts and Components, operational principles, passive components, Tunable sources and Tunable filters.

Suggested Readings:

1. Gerd Keiser, "*Optical Fiber Communications*", 3rd Edition, Tata McGraw- Hill publishing company Limited, New Delhi, 2000.
2. D.C.Agarwal, *"Fiber Optic Communication*", 2nd Edition, Wheeler publishing, New Delhi, 1993.
3. D. K. Mynbaev, L.L. Scheiner, "*Fiber-Optic Communications Technology*", Pearson education, New Delhi, 2006.

PE 752EC

LOW POWER VLSI DESIGN

(Professional Elective - V)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand major evolutions, effects on transistor characteristics
- To learn the Power estimation techniques of CMOS circuits.
- To familiarize with dynamic power optimization techniques.
- To familiarize with leakage power optimization techniques.
- Know Low Power Very Speed Dynamic Digital circuit designs.

Course Outcomes: Student will be

1. Understand major evolutions in MOS and its behaviour
2. Estimate power in CMOS circuits
3. Use dynamic power reduction techniques in designs
4. Use leakage power reduction techniques in designs
5. Use advance fast computation methods.

UNIT-I

MOS transistor major evolutions-Bulk CMOS technologies, SOI technologies, MOS transistor saturation and sub threshold currents, tunnel currents, Leakage current components, scaling effects, Innovative transistor architectures

UNIT-II

Power Estimation Techniques: Circuit Level – Modeling of Signals, Signal Probability Calculations, Statistical techniques for combinational circuits, Power estimation at circuit level, High Level Power Estimation.

UNIT-III

Power Optimization Techniques – I: Dynamic Power Reduction – Dynamic Power Component, Circuit Parallelization, Voltage Scaling Based Circuit Techniques, Circuit Technology – Independent Power Reduction, Circuit Technology Dependent Power Reduction;

UNIT-IV

Power Optimization Techniques – II: Leakage Power Reduction – Leakage Components, Design Time Reduction Techniques, Run-time Stand-by Reduction Techniques, Run-time Active Reduction Techniques, techniques to reduce leakage in Cache Memories.

UNIT-V

Power Optimization Techniques – III: Low Power Very Fast Dynamic Logic Circuits, high throughput CMOS circuit techniques, Low Power Arithmetic Operators- addition and multiplication, Energy Recovery Circuit Design

Suggested Readings:

1. Kaushik Roy and Sharat Prasad, "*Low-Power CMOS VLSI Circuit Design"*, Wiley Interscience Publications, 2000
2. Christian Piguet, "*Low Power CMOS Circuits Technology, Logic Design and CAD Tools"*, 1st Indian Reprint, CRC Press, 2010
3. Jan M Rabaey, A Chandrakasan, Borvioje N *"Digital Integrated Circuits Design Perspective*" PHI-2nd edition, 2005

PE 753EC

INTERNET OF THINGS

(Professional Elective - V)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Discuss fundamentals of IoT and its applications and requisite infrastructure
- Describe Internet principles and communication technologies relevant to IoT
- Discuss hardware and software aspects of designing an IoT system
- Describe concepts of cloud computing and Data Analytics
- Discuss business models and manufacturing strategies of IoT products

Course Outcomes: Student will be able to

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT
3. Design simple IoT systems with requisite hardware and C programming software
4. Understand the relevance of cloud computing and data analytics to IoT
5. Comprehend the business model of IoT from developing a prototype to launching a product.

UNIT- I

Introduction to Internet of Things

IOT vision, Strategic research and innovation directions, Iot Applications, Related future technologies, Infrastructure, Networks and communications, Processes, Data Management, Security, Device level energy issues.

UNIT- II

Internet Principles and communication technology

Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source.

UNIT- III

Prototyping and programming for IoT

Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

Techniques for writing embedded C code: Integer data types in C, Manipulating bits - AND, OR, XOR, NOT, Reading and writing from I/ O ports. Simple Embedded C programs for LED Blinking, Control of motor using switch and temperature sensor for arduino board.

UNIT- IV

Cloud computing and Data analytics

Introduction to Cloud storage models -SAAS, PAAS, and IAAS. Communication APIs, Amazon webservices for IoT, Skynet IoT Messaging Platform.

Introduction to Data Analytics for IoT - Apache hadoop- Map reduce job execution workflow.

UNIT- V

IoT Product Manufacturing - From prototype to reality

Business model for IoT product manufacturing, Business models canvas, Funding an IoT Startup, Mass manufacturing - designing kits, designing PCB,3D printing, certification, Scaling up software, Ethical issues in IoT- Privacy, Control, Environment, solutions to ethical issues.

Suggested Readings:

1. *"Internet of Things"* - Converging Technologies for smart environments and Integrated Ecosystems, River Publishers.
1. Adrian McEwen, Hakim Cassimally, "*Designing the Internet of Things",* Wiley India Publishers
2. Daneil W lewies, "*Fundamentals of embedded software: where C meets assembly",* Pearson.
3. Arshdeep Bahga*, "Internet of things -A hands on Approach"* Universities press.

PE 754EC

RF CIRCUIT DESIGN

(Professional Elective - V)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To introduce students the basic transmission line theory, single and multiport networks, RF component modeling.
- To offer students experience on designing matching and biasing networks & RF transistor amplifier design.
- To educate students fundamental RF circuit and system design skills.
- To extend the knowledge to analyze & Design the RF circuits using the high frequency passive components.
- To differentiate between RF, Digital and mixed circuit Design.

Course Outcomes: Student will be able to

1. Differentiate the Circuit Component Behavior at RF frequencies
2. Identify the Design Constraints at RF frequencies
3. Analyze RF circuits, networks and behavior based on scattering parameters.
4. Demonstrate capability of RF Design and development of various RF components.
5. Design RF Amplifies, Mixers, Filters, Dividers, Combiners, Oscillators and other sub blocks.

UNIT – I:

RF passive components & Transmission Line Analysis Importance of RF Design- Frequency Spectrum- RF Behaviour of Passive Components: High frequency resistors, High frequency capacitors, High frequency inductors. Chip components and circuit board considerations: chip resistors, chip capacitors, and surface Mount Inductors. Types of Transmission lines - Equivalent Circuit representation – R, L, C, G parameters of different line configurations. Terminated Lossless Transmission lines- special terminations: Short circuit, open circuit and quarter wave transmission lines. Sourced and loaded transmission lines: Power considerations, input impedance matching, return loss and insertion loss.

UNIT – II:

Smith chart & Single- and Multiport Networks: Reflection coefficient, Normalized impedance. Impedance transformation: Standing wave ratio, special transformation conditions – Admittance transformation- parallel and series RL&RC connections- basic definitions of single and multi port networks- interconnecting networks.

UNIT – III

RF filter Design: Scattering parameters: Definition, meaning, chain scattering matrix, conversion between S and Z parameters, Signal flow chart modelling and generalization. Basic Resonator and Filter configurations: Low pass, high pass, band pass and band stop type filters. Filter implementation using unit element and Kuroda's Identities Transformations- Coupled filters.

UNIT – IV:
Active RF Component Modeling & Matching and Biasing networks: Diode Modeling: nonlinear and linear models. Transistor models: Large signal and small signal BJT Models, Large signal small signal FET Models- Scattering parameter device characterization. Impedance Matching using discrete components: Two component matching networks, Forbidden regions, Frequency response and Quality factor, T and Pi matching networks. Amplifier classes of operation and biasing networks: Classes of operation and efficiency of Amplifiers, Biasing networks for BJT, biasing networks for FET.

UNIT – V:
RF Transistor Amplifier, Oscillator and Mixer Design: Characteristics of Amplifiers- Amplifier power relations: RF source, Transducer power gain, Additional power relations. Stability considerations: Stability circles, unconditional stability, and stabilization methods. Unilateral and Bilateral design for constant gain, Noise figure circles, and constant VSWR circles. Basic oscillator Model: Negative resistance oscillator, Feedback oscillator Design, Design steps, Quartz Oscillators – Fixed frequency, High frequency Oscillator – Basic Characteristics of Mixers: Concepts, Frequency Domain Considerations, Single ended Mixer design, Single and Double balanced Mixers.

Suggested Readings:

1. Reinhold Ludwig, Pavel Bsetchko, *"RF Circuit Design—Theory and applications*", Pearson Education India, 2000.
2. Devendra K.Misra, "*Radio Frequency and Microwave communication circuits – Analysis and Design",* Wiely Student Edition – John Wiley & Sons, Inc.
3. Peter L.D. Abrif, *"Design of RF and Microwave Amplifiers and Oscillators*", Artech House, 2000.

OE 701BM

MICRO ELECTRO-MECHANICAL SYSTEMS

(OPEN ELECTIVE-II)

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To introduce to basics of Micro-electro-mechanical systems
- To understand properties of materials involved in MEMS
- To pertain fabrication methods involved in MEMS manufacturing
- To apply the concepts for various applications

Course Outcomes: Upon completion of the course, the student will be able to

1. Elucidate basic concepts involved in MEMS technologies
2. Realize the properties of various materials involved in MEMS technologies
3. Apply the concepts and technologies involved in designing of MEMS
4. Relate different manufacturing processes involved in fabrication of MEMS
5. Recognize micro sensors, micro actuators and their applications in various fields.

UNIT I

Introduction to MEMS: What is MEMS, Historical Background, classification, Micro-engineering, importance of micro-engineering. Technological advancements in MEMS, advantages and disadvantages of MEMS.

UNIT II

MEMS materials: Materials used in MEMS. Material properties: electrical, mechanical, thermal, chemical, biological, optical and processing. Reliability issues of materials

UNIT III

Designing of MEMS: Design and analysis process for MEMS. Initial design process, structured design process. Commonly used design flow, structured design flow. Design flow for MEMS cad design. Design and verification flow for integrated MEMS.

UNIT IV

MEMS fabrication Techniques: Photolithography, materials for micromachining, bulk micromachining Surface micromachining, High aspect-ration-micromachining, assembly and system integration.

UNIT V

MEMS structures and devices: Mechanical sensors, mechanical actuators, micro-fluidic devices, optical/photonic micro-systems, biological transducers.

Suggested Readings:

1. Adams TM, Layton RA., *"Introductory MEMS: Fabrication and applications"*, 2010.
2. Tobergte DR, Curtis S., *"An Introduction to Micro-electro-mechanical Systems Engineering"* Second Edition. vol. 53. 2013.
3. Kreith F, Kreider JF., *"The MEMS Handbook*" CRC Press 2002.
4. Reza Ghodssi, Pinyen Lin, *"MEMS Materials and Processes Handbook"* Springer 2013
5. Gad-el-Hak M, *"MEMS applications"* 2nd edition, CRC press 2006.

OE 702CE

GREEN BUILDING TECHNOLOGY

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Exposure to the green building technologies and their significance.
- Understand the judicial use of energy and its management.
- Educate about the Sun-earth relationship and its effect on climate.
- Enhance awareness of end-use energy requirements in the society.
- Develop suitable technologies for energy management.

Course Outcomes: Student will be

1. Understand the fundamentals of energy use and energy processes in building.
2. Identify the energy requirement and its management.
3. Know the Sun-earth relationship vis-a-vis its effect on climate.
4. Be acquainted with the end-use energy requirements.
5. Be familiar with the audit procedures of energy.

UNIT- I

Overview of the significance of energy use and energy processes in building: Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications.

UNIT- II

Indoor environmental requirement and management: Thermal comfort - Ventilation and air quality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditoryrequirement.

UNIT- III

Climate, solar radiation and their influences: Sun-earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

UNIT- IV

End-use, energy utilization and requirements: Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building - Heat gain and thermal performance of building envelope - Steady and non-steady heat transfer through the glazed window and the wall - Standards for thermal performance of building envelope -Evaluation of the overall thermal transfer

UNIT- V

Energy management options: Energy audit and energy targeting - Technological options for energy management.

Suggested Readings:

1. Michael Bauer, Peter Mösle and Michael Schwarz, *"Green Building – Guidebook forSustainable Architecture"*, Springer, Heidelberg, Germany, 2010.
2. Norbert Lechner, *"Heating, Cooling, Lighting - Sustainable Design Methods for Architects",* Wiley, New York, 2015.
3. Mike Montoya, *"Green Building Fundamentals*", Pearson, USA, 2010.
4. Charles J. Kibert, *"Sustainable Construction - Green Building Design and Delivery*",John Wiley & Sons, New York, 2008.
5. Regina Leffers, *"Sustainable Construction and Design*", Pearson / Prentice Hall, USA,2009.
6. James Kachadorian, *"The Passive Solar House: Using Solar Design to Heat and CoolYour Home",* Chelsea Green Publishing Co., USA, 1997.

OE 703CS

INFROMATION SECURITY

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To learn legal and technical issues in building secure information systems
- To provide an understanding of network security
- To expose the students to security standards and practices

Course Outcomes: Student will be

1. Describe the steps in Security Systems development life cycle(SecSDLC)
2. Understand the common threats and attack to information systems
3. Understand the legal and ethical issues of information technology
4. Identify security needs using risk management and choose the appropriate risk control strategy based on business needs
5. Use the basic knowledge of security frameworks in preparing security blue print for the organization
6. Usage of reactive solutions, network perimeter solution tools such as firewalls, host solutions such as antivirus software and Intrusion Detection techniques and knowledge of ethical hacking tools
7. Use ethical hacking tools to study attack patterns and cryptography and secure communication protocols
8. Understand the technical and non-technical aspects of security project implementation andaccreditation

UNIT – I

Introduction: History, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access,the SDLC, the Security SDLC.

Need for Security: Business Needs, Threats, Attacks, and Secure Software Development

UNIT – II

Legal, Ethical and Professional Issues: Law and ethics in Information Security, Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security.

Risk Management: Overview, Risk Identification, Risk Assessment, and Risk Control Strategies, Selecting a Risk Control Strategy, Quantitative versus Qualitative Risk Control Practices, Risk Management discussion Points, and Recommended Risk Control Practices.

UNIT – III

Planning for Security: Security policy, Standards and Practices, Security Blue Print, Security Education, Continuity strategies.

Security Technology: Firewalls and VPNs: Physical Design, Firewalls, And Protecting Remote connections.

UNIT – IV

Security Technology: Intrusion Detection, Access Control, and other Security Tools: Intrusion Detection and Prevention Systems-Scanning, and Analysis Tools- Access Control Devices.

Cryptography: Foundations of Cryptology, Cipher methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for Secure Communications, Attacks on Cryptosystems

UNIT – V

Implementing Information Security: Information security project management, Technical topics of implementation, Non-Technical Aspects of implementation, Security Certification and Accreditation.

Security and Personnel: Positioning and staffing security function, Employment Policies and Practices, and Internal control Strategies.

Information Security Maintenance: Security management models, Maintenance model, and DigitalForensics.

Suggested Readings:

1. Michael E Whitman and Herbert J Mattord, "*Principles of Information Security*", Cengage Learning, 2011.
2. Thomas R Peltier, Justin Peltier, John Blackley, "*Information Security Fundamentals*",Auerbach Publications, 2010.
3. Detmar W Straub, Seymour Goodman, Richard L Baskerville, "*Information Security,Policy, Processes, and Practices",* PHI, 2008.
4. Mark Merkow and Jim Breithaupt *"Information Security Principle and Practices"*, Pearson Education, 2007

OE 704CS

DATA BASE MANAGEMENT SYSTEMS

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To introduce three schema architecture and DBMS functional components.
- To learn formal and commercial query languages of RDBMS.
- To understand the principles of ER modeling and theory of normalization.
- To study different file organization and indexing techniques.
- To familiarize theory of serializablity and implementation of concurrency control, andrecovery.

Course Outcomes: Student will be

1. Understand the mathematical foundations on which RDBMS are built.
2. Model a set of requirements using the Extended Entity Relationship Model (EER), transform an EER model into a relational model, and refine the relational model using theory of Normalization.
3. Develop Database application using SQL and Embedded SQL.
4. Use the knowledge of file organization and indexing to improve database application performance.
5. Understand the working of concurrency control and recovery mechanisms in RDBMS.

UNIT – I

Introduction: Database System Applications, Purpose of Database Systems, View of Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations Data, Database Languages, Relational Databases, Database Design, Object–based and Semi-structured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators.

Database Design and the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Constraints, Entity-Relationship Diagrams, Entity – Relationship Design Issues, Weak Entity Sets, Extended E-R Features, Database Design for Banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design

UNIT – II

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational – Algebra Operations, Extended Relational - Algebra Operations, Null Values, Modification of the Databases.

Structured Query Language: Data Definition, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null

UNIT – III

Advanced SQL: SQL Data Types and Schemas, Integrity Constraints, Authorization, Embedded SQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced SQL Features. Relational Database Design: Features of Good Relational Design, Atomic Domains and First Normal Form, Functional-Dependency Theory, Decomposition using Functional Dependencies.

UNIT – IV

Indexing and Hashing: Basic Concepts, Ordered Indices, B^+-tree Index Files, B-tree Index Files, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.

Index Definition in SQL Transactions: Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementationof Isolation, Testing for Serializability

UNIT – V

Concurrency Control: Lock-based Protocols, Timestamp-based Protocols, Validation-based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency of Index Structures.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems.

Suggested Readings:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "*Database System Concepts"*, McGraw-Hill International Edition, 6th Edition, 2010.
2. Ramakrishnan, Gehrke, "*Database Management Systems"*, McGraw-Hill InternationalEdition, 3rd Edition, 2003.
3. Elmasri, Navathe, Somayajulu, "*Fundamentals of Database Systems"*, Pearson Education,4th Edition, 2004.

OE 705EC

EMBEDDED SYSTEMS

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To gain knowledge to design embedded systems.
- To understand the processor selection criteria for Embedded System Design.
- To gain the knowledge of ARM Cortex on Zynq for embedded systems.
- To gain the knowledge of tool chain for embedded systems.
- To understand the importance of RTOS in building real time systems

Course Outcomes: Student will be

1. Design an embedded system.
2. Distinguish between RISC and CISC
3. Use the ARM Cortex for design of embedded system
4. Use Embedded Software Development Tools for Designing Embedded System applications
5. Apply their understanding in building real time systems

UNIT-I

Introduction To Embedded Systems: The Embedded Design Life Cycle - Product Specification, Hardware/Software Partitioning, Iteration and Implementation, Detailed Hardware (selection fo processor) and Software Design, Hardware/Software Integration, Product Testing And Release, Maintenance and Upgradation.

UNIT-II

ARM Embedded Systems: The RISC design philosophy, The ARM design philosophy, ARM processor fundamentals, registers, current program status register, pipeline, exceptions, interrupts, and vector table, core extensions, architecture revisions, ARM processor families.

UNIT-III

Embedded processing with ARM CORTEX on Zynq: Fundamentals of FPGA, types of FPGA, case study of Xilinx FPGA, Processing System, programmable logic, programmable logic interfaces, security, Zynq 7000 family members, Zynq versus standard FPGA, Zynq versus standard processor.

UNIT-IV

Embedded Software Development Tools: Host and Target Machines, Cross Compilers, Cross Assemblers, Tool Chains, Linkers/Locators for Embedded Software, Address Resolution, and Locator Maps. Getting Embedded Software into Target System: PROM programmer, ROM emulator, In Circuit- Emulators, Monitors, Testing on Your Host Machine - Instruction Set Simulators, Logic Analyzers.

UNIT-V

Introduction to Real Time Operating Systems: Tasks and task states, tasks and Data, Semaphores and shared data. Operating system services: Message queues, mailboxes and pipes, timer functions, events, memory management, Interrupt routines in an RTOS environment.

Suggested Readings:

1. Arnold S Berger, "*Embedded Systems Design"*, South Asian edition, CMP Books, 2005.
2. Andrew Sloss, Dominic Symes, Chris Wright, *ARM "System Developer's Guide: Designingand Optimizing System Software",* Elsevier, 2004.
3. Louise H Crockett, Ross. A. Elliot et al "*The Zynq Book*", Edition 1, Strathclyde academicmedia, July 2014.
4. David E Simon, "*An Embedded software primer*", Pearson, 2012

OE 706EC

VERILOG HDL

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To familiarize with various modeling styles: structural, dataflow and behavioral of Verilog HDL.
- To develop combinational and sequential circuits using various modeling styles of Verilog HDL
- To design and develop Verilog HDL models of data path and control units of Central Processing Unit (CPU)
- To learn Synthesis and FPGA design flow.
- To design and develop real time applications: Booth's multiplier, Divider, hardwired control for basic CPU, FIR filter.

Course Outcomes: Student will be

1. Implement and distinguish different Verilog HDL modeling styles
2. Construct and analyze Verilog HDL models of combinational and sequential circuits
3. Design and develop Verilog HDL modeling and test bench for digital systems for the given specifications
4. Outline FPGA design flow and timing analysis

UNIT - I

Introduction to HDL: Overview and Importance of HDLs, Differences between HLL, HDL and ALP. Design methodologies, Modules, Lexical Conventions, Number Specifications, Strings, Identifiers and Keywords Data types, System task and compiler Directives, Port declaration and port connection rules

UNIT - II

Structural and Dataflow modeling: gate-level modeling, delays, hazards, dataflow modeling: Continuous Assignments, Delays, Expressions, Operators and Operands, Operator Types and Design Examples

UNIT - III

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, multi-way branching, Loops, Sequential and Parallel blocks, Generate blocks. Combinational, sequential logic modules Simulation: Types of Simulation, Event driven Simulation and Cycle Based Simulation; design examples.

UNIT - IV

Synthesis and Verification: Tasks and Functions: Differences between Tasks and Functions, Tasks and Functions. Verilog HDL synthesis, synthesis, Application Specific IC (ASIC) and Field Programmable Gate Array (FPGA) design flow. Verification: Timing analysis and Test bench design. Design examples.

UNIT - V

Real time implementations: Fixed-Point Arithmetic modules: Addition, Multiplication, Division, Arithmetic and Logic Unit (ALU), Timer, Universal Asynchronous Receiver and Transmitter (UART), DSP modules: FIR and IIR filters, CPU design: Data path and control units.

Suggested Reading:

1. Samir Palnitkar, *"Verilog HDL A Guide to Digital Design and Synthesis,"* 2nd Edition, Pearson Education, 2006.
2. Ming-Bo Lin, "*Digital System Designs and Practices: Using Verilog HDL and FPGA,"* Wiley India Edition, 2008.
3. J. Bhasker, *"A Verilog HDL Primer*," 2nd Edition, BS Publications, 2001.

OE 707EC

SATELLITE COMMUNICATION AND APPLICATIONS

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To familiarize with basic concepts related to satellite Communication.
- To understand Sub-Systems of Satellites and Launches.
- To design the Earth Station antennas.
- To know about the parameters affecting the Satellite System Performance.
- To understand the applications of satellites.

Course Outcomes: Student will be

1. Able to have knowledge about the Satellite communications Principles and Properties.
2. Able to know about the Space craft subsystems and Launch vehicles.
3. Able to design the Satellite Earth station antennas
4. Able to analyze the effects of various parameters on Satellite System performance.
5. Able to understand the applications of Satellite Communication.

UNIT–I

Origin of Satellite communications, A Brief History of Satellite Communication, Basic principles and properties of satellite communication. Earth segment, Space segment, Interpretation of Kepler's Laws. Orbital Mechanics: The Equation of the Orbit, Describing the Orbit, Locating the Satellite in the Orbit, Orbital effects in communication system Performance: Doppler shift, Range variation, Eclipse and Sun-Transit Outage.

UNIT– II

Space craft sub systems, Equipment Reliability and Space Qualification: Space Qualification, Reliability, and Redundancy, Satellite launch and launch vehicles and Mechanics of Launching a Synchronous Satellite.

UNIT– III

Earth Stations: Earth Station Design for Low System Noise Temperature, Design of large antennas and small earth station antennas. Low noise amplifiers and High power Amplifiers for Satellite communication.

UNIT– IV

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T ratio: Noise Temperature, calculation of System Noise Temperature, Noise Figure and Noise Temperature, Propagation on Satellite-Earth paths: Attenuation, depolarization, atmospheric absorption, Tropospheric Multipath effects and Land and Sea Multipath, Multipath Effects in System Design, Faraday rotation in the Ionosphere, Ionospheric scintillations, Rain and ice effects.

UNIT– V

Satellite Navigation Applications: Global and Regional Satellite Navigation Systems- Operating Principles, Advantages, Limitations, Current Status and Applications, Remote Sensing Satellites.

Suggested Readings:

1. Wilbur L. Pitchand and Henri G. Suyderhoud, Robert A. Nelson, "*Satellite Communication Systems Engineering",* 2nd edn.3rd Impression, Pearson Education.2008.
2. Timothy Pratt and Charles Nestian. W, "*Satellite Communication",* John Wiley and Sons, 1988.
3. Tri T. Ha, "*Digital Satellite Communication"*, Tata McGraw- Hill, Special Indian Edition2009.

OE 708EE

OPTIMIZATION TECHNIQUES

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the need and basic concepts of operations research and classify the optimization problems.
- To study about the linear programming and non-linear programming concepts and their applications
- To understand various constrained and un-constrained optimization techniques and their applications.
- To understand the concepts and implementation of Genetic Algorithms to get the optimum solutions
- To study the concepts of Metaheuristics Optimization techniques

Course Outcomes: Student will be

1. Analyze any problem of optimization in an engineering system and able to formulate a mathematical model to the problem and solving it by the techniques that are presented.
2. Solve problems of L.P. by graphical and Simplex methods.
3. Apply various constrained and un-constrained optimization techniques for the specific problems.
4. Could able to implement the Genetic Algorithms to solve the for optimum solution.
5. Understands the concepts to use the Metaheuristics Optimization techniques

UNIT – I

Introduction: Definitions, Characteristics, Objective function, Classification of optimization problems, Engineering applications and limitations. Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints and Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Condition

UNIT – II

Linear Programming: Definitions and Formulation of the LPP, Construction of L.P. Models, Slack and surplus variables, Standard form, Canonical form and matrix form of LP Problems. Artificial Variables, solution by the Big-M method, Duality principle, Dual problems and numerical problems.

UNIT – III

Random Search Methods concepts: Direct Search Methods - Univariate Method, Gradient of a Function, Indirect Search Methods - Gradient of a Function, Steepest Descent (Cauchy) Method, Newton's Method.

UNIT – IV

Binary Genetic Algorithm: Genetic Algorithms Natural Selection on a Computer, Components of a Binary Genetic Algorithm. Selecting the Variables and the Cost Function. Variable Encoding and Decoding, the Population, Natural Selection, Selection, Mating. Mutations, the Next Generation and Convergence, Components of a Continuous Genetic Algorithm.

UNIT – V

Metaheuristics Optimization: Concepts of Simulated Annealing, Theoretical approaches, Advantages and disadvantages, applications, Ant Colony Algorithms - Introduction, Collective behavior of social insects, Formalization and properties of ant colony optimization.

Suggested Readings:

1. Rao, S.S., *"Engineering Optimization: Theory and Practice"*, John Wiley & Sons, Inc., 2009
2. Taha, H.A., *"Operations Research, Pearson Education India"*, New Delhi, India, 2008.
3. Randy L. Haupt and Sue Ellen Haupt, *"Practical genetic algorithms"* second edition, a John Wiley & sons, inc., publication -2004.
4. Sharma J.K., "*Operation Research: Theory and Applications"* Fifth Edition, Macmillan Publishers, New Delhi, India, 2013.
5. J. Dreo A. Petrowski, P. Siarry E. Taillard, *"Metaheuristics for Hard Optimization"* Springer.

OE 709EE

NON-CONVENTIONAL ENERGY SOURCES

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the different types of energy sources
- To Understand the need of non-conventional energy sources and their principles
- To understand the limitations of non-conventional energy sources
- To outline division aspects and utilization of renewable energy sources for diriment application
- To analyze the environmental aspects of renewable energy resources

Course Outcomes: Student will be able to

1. Know the different energy resources and need of renewable energy resources
2. Understand the concepts of working of fuel cell systems along with their applications
3. Describe the use of solar energy and the various components and measuring devices used in the energy production and their applications
4. Appreciate the need of Wind Energy and their classification and various components used in energy generation and working of different electrical wind energy system
5. Understand the concept of OTEC technology, Biomass energy resources and different types of biogas Plants used in India

UNIT- I

Review of Conventional and Non-Conventional energy sources, Need for non-conventional energy sources Types of Non-conventional energy sources, Fuel Cells, Principle of operation with special reference to H2O2 Cell, Classification and Block diagram of fuel cell systems, Ion exchange membrane cell, Molten carbonate cells, Solid oxide electrolyte cells, Regenerative system, Regenerative Fuel Cell, Advantages and disadvantages of Fuel Cells, Polarization, Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy, Solar radiation and its measurements, Solar Energy collectors, Solar Energy storage systems, Solar Pond, Application of Solar Pond, Applications of solar energy.

UNIT-III

Wind energy, Principles of wind energy conversion systems, Nature of wind, Power in the Wind, Basic components of WECS, Classification of WECS, Site selection considerations, Advantages and disadvantages of WECS, Wind energy collectors, Wind electric generating and control systems, Applications of Wind energy, Environmental aspects.

UNIT-IV

Energy from the Oceans, Ocean Thermal Electric Conversion (OTEC) methods, Principles of tidal power generation, Advantages and limitations of tidal power generation, Ocean waves, Wave energy conversion devices, Advantages and disadvantages of wave energy, Geo-thermal Energy, Types of Geo-thermal Energy Systems, Applications of Geo-thermal Energy.

UNIT-V

Energy from Biomass, Biomass conversion technologies / processes, Photosynthesis, Photosynthetic efficiency, Biogas generation, Selection of site for Biogas plant, Classification of Biogas plants, Details of commonly used Biogas plants in India, Advantages and disadvantages of Biogas generation, Thermal gasification of biomass, Biomass gasifies.

Suggested Readings:

1. Rai G.D, *"Non-Conventional Sources of Energy",* Khandala Publishers, New Delhi, 1999.
2. M. M. El-Wakil, *"Power Plant Technology"*, McGraw Hill, 1984.

OE 710ME

STARTUP ENTREPRENEURSHIP

(Open Elective - II)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise by creative thinking and shape ideas into reality.
- To understand action driven business plan and learn to prepare project budget.

Course Outcomes: Student will be able to

1. Think creatively and transform ideas into reality.
2. Differentiate market transforming strategy.
3. Create a complete business plan and workout the budget plan.

UNIT – I

Creativity & Discovery: Definition of Creativity, self-test creativity, discovery and delivery skills, The imagination threshold, Building creativity ladder, Collection of wild ideas, Bench marking the ideas, Innovative to borrow or adopt, choosing the best of many ideas, management of tradeoff between discovery and delivery, Sharpening observation skills, reinventing self, Inspire and aspire through success stories

UNIT – II

From Idea to Startup: Introduction to think ahead backward, Validation of ideas using cost and strategy, visualizing the business through value profile, activity mapping, Risks as opportunities, building your own road map

UNIT – III

Innovation career lessons: Growing & Sharing Knowledge, The Role of Failure In Achieving Success, Creating vision, Strategy, Action & Resistance: Differentiated Market Transforming Strategy; Dare to Take Action; Fighting Resistance; All About the startup Ecosystem; Building a Team; Keeping it Simple and Working Hard.

UNIT – IV

Action driven business plan: Creating a completed non-business plan (a series of actions each of which moves your idea toward implementation), including a list of the activities to be undertaken, with degrees of importance (scale of 1 to 3, where 1 is 'most important'). A revision of the original product or service idea, in light of information gathered in the process, beginning to design the business or organization that will successfully implement your creative idea. Preparing an activity map.

UNIT – V

Startup financing cycle: Preparing an initial cash flow statement, showing money flowing out (operations; capital) and flowing in. Estimate your capital needs realistically. Prepare a bootstrapping option (self-financing). Prepare a risk map. Prepare a business plan comprising five sections: The Need; The Product; Unique Features; The Market; Future Developments. Include a Gantt chart (project plan – detailed activities and starting and ending dates); and a project budget.

Suggested Readings:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management"*, Himalaya Publishing House, 1997.
2. Prasanna Chandra, *"Project – Planning, Analysis, Selection, Implementation and Review",* Tata McGraw-Hill Publishing Company Ltd., 1995.
3. B. Badhai, "*Entrepreneurship for Engineers*", Dhanpath Rai & Co., Delhi, 2001.
4. Stephen R. Covey and A. Roger Merrill, "*First Things First",* Simon and Schuster, 2002.
5. Robert D. Hisrich and Michael P.Peters, *"Entrepreneurship*", Tata McGraw Hill Edition, 2002.

OE 711ME

NANO TECHNOLOGY

(Open Elective - II)

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To familiarize Nano materials and technology.
- To understand Nano structures, fabrication and special Nano materials.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. To understand that properties of materials are size and shape dependent
2. To learn key concepts in understanding fabrication techniques
3. To critically analyze properties of nanomaterial for future engineering applications
4. To understand various approaches to synthesis of nanostructures

UNIT-I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nano Technology,
Bottom-up and Top-down approaches, challenges in Nanotechnology.

UNIT-II

Materials of Nano Technology: Introduction-Si-based materials, Ge-based materials, Smart materials, metals, Ferroelectric materials, Polymer materials, GaAs & InP (III-V) group materials, Nano tribology and Materials, Principles and analytical techniques of XRD, SEM, TEM and STM/AFM.

UNIT-III

Nano Structures: Zero dimensional Nano structure (Nano Particles)- Synthesis procedure, characterization techniques, properties and applications of Nano Particles
One dimensional Nano structures (Nano Wires, Nano Tubes)- Various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes.

UNIT-IV

Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping) MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques).

UNIT-V

Special Nano Materials: Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal- ceramics and polymer-Ceramics), Characterization procedures, applications.
Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications.

Suggested Reading:

1. A.K.Bandyopadyay, "*Nano Materials",* New Age Publications, 2007.
2. T. Pradeep, *"Nano: The Essentials: Understanding Nanoscience and Nanotechnolgy",* Tata McGraw-Hill, 2008.
3. Carl. C. Koch, *"Nano Materials Synthesis, Properties and Applications",* Jaico Publishing House, 2008.
4. Willia Illsey Atkinson, *"NanoTechnology*", Jaico Publishing House, 2009.

HS 701ME

INDUSTRIAL AND FINANCIAL MANAGEMENT
(Only for ECE)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand various types of organizational structures, manufacturing processes
- Importance of plant layout and the role of scheduling function in optimizing the utilization of resources
- To understand the importance of quality, inventory control and concepts like MRP I and MRP II
- To understand the nature of financial management and concepts like breakeven analysis, depreciation and replacement analysis

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems
2. Role of scheduling function in better utilization of resources
3. Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP –II.
4. Know the different terminology used in financial management and apply different techniques of capital budgeting
5. Analyse and various types of costs involved in running an industrial organization

UNIT-I

Types of organizations, organizational structures. Designing Products, Services and Processes: New product design and development. Product life cycle: phasing multiple products.

Manufacturing process Technology: Product, job shop, batch, assembly line and continuous process technology; flexible manufacturing systems. Design of Services, service process technology operations capacity; capacity planning decisions, measuring capacity; estimating future capacity needs.

UNIT-II

Locating production and services facilities, effects of location and costs and revenues, factor rating, simple median model (linear programming) Layout planning; process layout; product layout — Assembly lines; line balancing manufacturing cellular layout. Scheduling systems and aggregate planning for production and services; loading assignment algorithm; priority sequencing and other criteria.

UNIT-III

Quality planning and Control: basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. Economics of quality and measurement of the cost of quality. Quality considerations in design. Process control: machine and process capability analysis. Use of control charts and process engineering techniques for

implementing the quality plan. Acceptance sampling: single, double and multiple sampling, operating characteristic Curve - calculation of producers risk and consumer's risk.

UNIT-IV

Inventory control: deterministic and stochastic inventory models; variable demand; lead time, specific service level, perishable products and service. Inventory control in application; concepts for the practioners; saving money in inventory systems; ABC classifications. Inventory control procedures; Quantity - reorders versus periodic inventory systems; material requirement planning (MRP); MRP as a scheduling and ordering system; MRP system components; MRP computational procedure; Detailed capacity planning; MRP - limitation and advantages; Manufacturing Resources Planning (MRP-II).

UNIT-V

Elements of cost, overheads, breakeven analysis, depreciation, replacement analysis. Nature of financial management-time value of money, techniques of capital budgeting and method, cost of capital, financial leverage.

Suggested Reading:

1. Buifa and Sarin, *"Production and operations management*" - Wiley Publications.
2. I.M. Pandey, *"Elements of Financial Management"* Vikas Publications, New Delhi, 1994.
3. James C. Van Home & John, M. Wachowicz, Jr., *"Fundamentals of Financial Management*", Pearson Education Asia, 11 Th ed. 2001.

PC 751EC

MICROWAVE LABORATORY
(Laboratory)

Instruction: 2P hours per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits: 1

Course Objectives:
- To define the range of frequencies for operation in microwave engineering.
- To discover the functioning of microwave components.
- To verify the various Characteristics of Active and Passive Microwave Devices Practically.
- To Measure Different parameters of an Antenna.
- To find Practically Optical Fiber Characteristics.

Course Outcomes: Student will be
1. Study the characteristics of microwave sources.
2. Estimate the guide wave length and free space wave length of a wave.
3. Analyze the characteristics of microwave devices.
4. Plot the radiation characteristics of UHF and microwave antennas.
5. Analyze the fiber optic analog and digital link characteristics.

List of Experiments

A. Microwave Source Characteristics
1. Reflex Klystron Characteristics
2. Gunn diode Characteristics

B. Waveguide, Component Characteristics
1. Measurement of standing wave pattern, VSWR measurement, Low & High VSWR measurements.
2. Measurement of Frequency, wavelength, group and phase velocity.
3. Measurement of an unknown load characteristics of windows.
4. Directional Coupler Characteristics, Coupling, Directivity, and Isolation Measurements.
5. E plane, H plane and Magic Tee characteristics.
6. Characteristics of Circulator, Isolator, Measurements of S-parameters through insertion loss and isolation.

C. Antenna Characteristics
1. Measurement of principle plane radiation patterns for horn, Yagi Uda, folded dipole.
2. Measurement of gain & input impedance.
3. Linear array characteristics.
4. Measurement of return loss with Vector Network Analyzer.

D. Optical Communication
1. Optical Transmitter & Receiver Characteristics (Source' & Detector).
2. Optical Fiber Characteristics: Attenuation, Numerical aperture, splicing losses (step & graded index).
3. Modulation & Demodulation Techniques.
4. Analog/Digital Transmission link characteristics.

E. Satellite Communication

1. Analysis of user position accuracy of GAGAN and GPS for single frequency GPS/GAGAN receiver.
2. Analysis of User position under various conditions using Single frequency receiver

Suggested Readings:

1. Samuel Y. Liao, "*Microwave Devices and Circuits"*, PHI, 3rd Edition, 1994.
2. Pozar D.M., "*Microwave Engineering",* John Wiley & Sons 3 rd edition, 2005.

PW 751EC

MAJOR PROJECT PHASE - 1

Instruction: 4 hours per week *Duration of SEE:*
CIE: 50 marks *SEE:*
Credits: 2

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

1. demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. evaluate different solutions based on economic and technical feasibility
3. effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize itin the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:

Collection of project topics/ descriptions from faculty members (Problems can also beinvited from the industries)

Grouping of students (max 3 in a group)Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on theirown ideas or as suggested by the project guide

Seminar schedule will be prepared by the coordinator for all the students from the 5th week to thelast week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the awardof sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

1. Problem definition and specification
2. Literature survey
3. Broad knowledge of available techniques to solve a particular problem.
4. Planning of the work, preparation of bar (activity) charts
5. Presentation- oral and written.

PW 752EC

SELF STUDY PROJECT

Instruction: 4 hours per week *Duration of SEE:*
CIE: 50 marks *SEE:*
Credits: 2

Course Objectives:

- Understanding real life problems
- Problem solving techniques
- Working independently
- Drawing conclusions from analysis
- Date interpretation & presentation skills

Course Outcomes: Student will be able to

1. Use of library, literature review
2. Hunting/ Understanding the problem of social relevance / practical importance
3. Learn data analysis/ synthesis
4. Learn to choose right path/ optimum solutions
5. Lear presentation (Oral/technical/professional writing skills)

Procedure:

1. Student will choose problem on his/her own depending on his/her interest
2. Department will designate one coordinator in each semester for this course
3. Student will choose on their own, their mentor, who can be from department/ from other department or outside college (from industry/National organisations)
4. Topic need not be in ECE. It can be from any discipline but should have social relevance/practical importance.
5. Student will carry out work on his/her own by carrying out systematic literature survey, data/information collection, hence identify the problem.
6. Analyse/synthesis the data/information, choose proper tool/technique to solve the problem.
7. Should be able to interpret data and draw concrete conclusions.
8. Should write professional/technical report (Max. 50 pages per semester) giving all details, references, conclusion, and scope for future work, underline importance of the work carried out.
9. Will present his work before mentor/HOD/one examiner (from sister department)
10. Marks to be awarded by examining report and performance in defence (Viva) to be conducted by mentor and external examiner (from other department)

Self-Study project will be carried out independently by each student (not in group). If a single big problem is identified, three or four students can attempt, but activity of each student will be separate, report will be separate.

PW 961EC

SUMMER INTERNSHIP*

Instruction: 6 weeks *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: --

Course Objectives:

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers andgive an opportunity for useful interaction with them and familiarize with work culture andethics of the industry.

Course Outcomes: Student will be

1. Able to design/develop a small and simple product in hardware or software.
2. Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
3. Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
4. Able to implement the selected solution and document the same.

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Electronics Industry / R & D Organization / National Laboratory/Any other program approved by the department for a period of 8 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the industry guide.

After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessional are to be based on the performance of the student at the work place to be judged by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co- ordinate the overall activity of Summer Internship.

***Students have to undergo summer internship of 6 Weeks duration at the end of semester VI andcredits will be awarded after evaluation in VII semester**

SCHEME OF INSTRUCTION
B.E. (ECE)
VIII - SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
Theory									
1	**Professional Elective-VI**		3	0	0	3	30	70	3
	PE 861EC	Wireless Sensor Networks							
	PE 862EC	Introduction to Software Defined Radio							
	PE 863EC	GRNSS and Augmentation Systems							
	PE 864EC	Radar Systems							
2	OE#	Open Elective –III	3	0	0	3	30	70	3
3	PW 851EC	Major Project Phase –II	0	0	12	12	50	100	6
4	PW 852EC	Self-Study Project	0	0	0	4	50	-	2
	Total		**6**	**0**	**12**	**22**	**160**	**240**	**14**

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L	:	Lectures
T	:	Tutorials
P	:	Practicals
CIE	:	Continuous Internal Evaluation
SEE	:	Semester End Examination
PC	:	Professional Core
PE	:	Professional Elective
OE	:	Open Elective
HS	:	Humanities and Social Sciences
PW	:	Project Work

Open Elective-III

1. OE801BM Basic Medical Equipment
2. OE802CS Data Science Using R
3. OE803EC Mobile Communication
4. OE804EC Internet of Things and Applications
5. OE805EC Global and Regional Satellite Navigation System
6. OE806EE Applications of Electrical Energy
7. OE807ME Composite Material Applications
8. OE808ME Industrial Administration and Financial Management (**Except ECE**)
9. OE809CS Software Engineering
10. OE810CS Python Programming
11. OE811CE Cyber Security

PE 861EC

WIRELESS SENSOR NETWORKS

(Professional Elective - VI)

Instruction: 3L hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.
- To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.

Course Outcomes: Student should be able

1. To understand the state-of-the-art in network protocols, architectures and applications
2. To Explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks
3. To Describe the MAC protocol issues of Adhoc and sensor networks
4. To Discuss the WSN routing issues by considering QoS measurements
5. To understand the state-of-the-art techniques and protocols in QoS and Energy management for wireless sensor networks.

UNIT - I

Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

UNIT - II

Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

UNIT - III

MAC Protocols : Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

UNIT - IV

Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

UNIT - V

QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

Suggested Readings:

1. C. Siva Ram Murthy, and B. S. Manoj, *"AdHoc Wireless networks* ", Pearson Education - 2008.
2. Feng Zhao and Leonides Guibas, *"Wireless sensor networks* ", Elsevier publication - 2004.
3. Jochen Schiller, *"Mobile Communications"*, Pearson Education, 2nd Edition, 2003.
4. William Stallings, *"Wireless Communications and Networks "*, Pearson Education – 2004
5. Holger Karl and Andreas Willing, *"Protocols and Architectures for Wireless Sensor Networks",* John Wiley and Sons, 2005.
6. Waltenegus Dargie and Christian Poellabauer, *"Fundamentals of Wireless Sensor Networks:Theory and Practice",* First Edition, John Wiley and Sons, 2010.

PE 862EC

INTRODUCTION TO SOFTWARE DEFINED RADIO

(Professional Elective - VI)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To provide fundamental concepts in SDR.
- To explore the reconfigurable features of modern radio communication systems.
- To demonstrate SDR on any DSPs and FPGAs.

Course Outcomes: Student will be able to

1. Understand the basic architecture and design principles of SDR.
2. Analyze the parameters of analog RF components as front-end block in implementation of SDR.
3. Understand the concepts of digital converter and frequency converter fundamentals.
4. Understand the digital hardware architectures and development methods.
5. Implement SDR on available hardware devices like DSPs and FPGAs.

UNIT – I

Introduction to Software Defined Radio: A Traditional Hardware Radio Architecture, Signal Processing Hardware History, Software Defined Radio Project Complexity-Challenges and issues regarding the implementation of SDR.

UNIT – II

A basic software defined radio architecture transmission Lines: Introduction to 2G Radio Architectures, Hybrid Radio Architecture, Basic Software Defined Radio Block Diagram, System Level Functioning Partitioning, Digital Frequency Conversion Partitioning

UNIT – III

Signal Processing Hardware Components: Introduction to SDR Requirements for Processing Power DSPs, DSP Devices, DSP Compilers, Reconfigurable Processors, Adaptive Computing Machine FPGAs.

UNIT – IV

Software architecture and components: Introduction, Major Software Architecture Choices, Hardware –Specific Software Architecture, Software Standards for Software Radio, Software Design Patterns, Component Choices, Real Time Operating Systems, High Level Software Languages, Hardware Languages.

UNIT – V

Smart antennas using software radio:

Introduction, 3G smart Antenna Requirements, Phased Antenna Array Theory, Using Software Radio Principles to Antenna Systems, Smart Antenna Architectures, Optimum Combining/ Adaptive Arrays, DOA Arrays, Beam Forming for CDMA, Downlink Beam Forming.

Suggested Readings:

1. Paul Burns, "*Software Defined Radio for 3G",* Artech House, 2002
2. Tony J Rouphael, "*RF and DSP for SDR",* Elsevier Newnes Press, 2008
3. JoukoVanakka, *"Digital Synthesizers and Transmitter for Software Radio*", Springer, 2005

PE 863EC

GRNSS AND AUGMENTATION SYSTEMS

(Professional Elective - VI)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To explain the basic principle of GPS and its operation.
- To make the students to understand signal structure, errors, coordinate systems
- To make the students understand the GPS navigation and observation files.
- Highlight the importance of integrating GPS with other systems.
- To demonstrate the principle of DGPS and to facilitate the various augmentation systems.

Course Outcomes: Student will be able to

1. Understand the principle and operation of GPS.
2. Frame various coordinate systems for estimating position.
3. Estimate the various errors and their effect on position estimation.
4. Use GPS in various fields such as navigation, GIS etc.
5. Apply DGPS principle and can also analyze various augmentation systems.

UNIT- I

GPS fundamentals: Trilaiteration, Transit, GPS Principle of Operation, Architecture: Space, Control and User Segments, Operating frequencies, Orbits, Keplerian elements.

UNIT- II

GPS and UTC Time, Signal structure, SPS and PPS services, C/A and P-Codes, Geometry of ellipsoid, geodetic reference system, Geoid and Ellipsoid and Regional datum : Earth Centered Earth Fixed (ECEF) and Earth Centered Inertial (ECI) Coordinate systems and World Geodetic System (WGS 84) datum, Types of receivers, Spoofing and Anti-spoofing.

UNIT- III

GPS Error Models: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Multipath; GPS Navigation and Observation data formats, Various DOPs.

UNIT- IV

GPS Modernization: Future GPS satellites, New signals and their benefits, New Control Segment, Principle of operation of DGPS, architecture and limitations, GPS Applications: Surveying Mapping Marine, air and land Navigation, Military and Space Application. GPS Integration with Geographic Information System (GIS), Inertial Navigation System (INS), Pseudolite and Cellular.

UNIT- V

Other GRNSS: GLONASS, GALILEO, QZNSS, CNSS and IRNSS System. Relative advantages of SBAS, SBAS features and Principle of operation of Wide area augmentation system (WAAS), GPS Aided GEO Augmented Navigation (GAGAN) and Ground Based Augmentation System (GBAS): Local Area Augmentation System (LAAS).

Suggested Readings:

1. Ahmed El-Rabbany, *"Introduction to GPS",* Artech House Publishers, 2/e, Boston 2006.
2. Elliot D Kaplan and Christopher J Hegarty, "*Understanding GPS principles and applications",* Artech House Publishers, 2/e Boston & London 2005.
3. B.Hofmann-Wellenhof, H.Lichtenegger, and J.Collins, *"GPS Theory and Practice,"* Springer Verlog, 5/e, 2008.

PE 864EC

RADAR SYSTEMS

(Professional Elective - VI)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To familiarize with basic concepts of radar systems.
- To understand different Radar Systems.
- To know about Radar antennas.
- To know the propagation effects on a radar signal.
- To understand tracking radar principles.

Course Outcomes: Student will be

1. Able to understand the components of a radar system.
2. Able to demonstrate the function of FMCW radar.
3. Able to analyze the concept of MTI radar systems.
4. Able to incorporate the effects of environment condition in a radar system.
5. Able to apply appropriate mathematical and computer models relevant to radar systems to calculate system performance.

UNIT- I

Radar Systems: Radar Block diagram and operation, Applications of Radar. Radar frequencies, Radar Range Equation, Radar Cross Section of target, Prediction of range performance, Minimum detectable signal, Receiver noise figure, Effective noise temperature, Signal to noise ratio, System losses, False alarm time and probability of false alarm, Integration of radar pulses, Pulse-repetition frequency and range ambiguities. Swerling's Models.

UNIT- II

CW and FMCW Radars: Doppler effects, CW Radar, FMCW Radar, Multiple frequency CW radar, Low noise front-ends, A-scope, B-scope, PPI Displays, and Duplexers.

UNIT- III

MTI and Pulse Doppler Radar: MTI radar, Delay line canceller, Multiple and staggered prf, Blind speeds, Limitations to MTI performance, MTI using range gated Doppler filters, Pulse Doppler radar, Non coherent radar. CFAR techniques in Radar Detection

UNIT- IV

Tracking Radar: Sequential Lobing, Conical scan, Monopulse - Amplitude comparison and Phase comparison methods, tracking in range and in Doppler, Acquisition, and Comparison of Trackers.

UNIT- V

Search Radar: Track while scan radars, Search radar range equation, Search scans, Effect of surface reflection, Line of Sight (LOS), Propagation effects: Propagation over a plane earth, the round earth, Refraction, Anomalous propagation, Diffraction, Attenuation by atmospheric gases, Environmental noise.

Suggested Readings:

1. Skolnik, Merrill I, *"Introduction to Radar Systems"*, MGH, third edn. 2001.
2. Barton. David K, *"Modern Radar System Analysis*", Artech House, 1988.
3. Peebles PZ, *"Radar Principles*", John – Willey, 2004.

OE 801BM

BASIC MEDICAL EQUIPMENT

(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- State the Physiological reasons for using a particular piece of Biomedical Equipment.
- Describe the operating principles of a wide range of biomedical equipment.
- To familiarize the latest technologies of modern medicine
- To make learners able to use new and updated diagnostic methodologies
- To make learners capable enough of adopting the methods of recovery and improvinghealth with a service approach

Course Outcomes: Student will be able to

1. Perform tests to assess the performance and safety of various Equipment's.
2. Learn the maintenance of biomedical equipment.

UNIT – I

Medical Monitoring and recording: Patient monitoring: System concepts, bedside monitoring systems, central monitors, heart rate and pulse rate measurement. Temperature measurement Blood pressure measurement: Direct and indirect methods. Respiration rate measurement: Impedance pneumograph, Apnoea detectors. Ambulatory monitoring: Arrhythmia monitor, data recording, replay and analysis, Telemetry.

UNIT – II

Physiotherapy and Electrotherapy Equipment: Diathermy machines: Short wave diathermy, Microwave diathermy and ultrasonic diathermy Electro diagnostic/Therapeutic apparatus: Nerve muscle stimulator, Functional electrical stimulator etc.

UNIT – III

Medical Imaging Equipment:

X-Ray machines: Properties and production of X-Rays, X-ray machine, Image Intensifier. X-ray computed tomography: basic principle and construction of the components. Ultrasonic Imaging: Physics of ultrasonic waves, medical ultrasound, and basic pulse echo apparatus. Magnetic Resonance Imaging: Principle, Image reconstruction techniques, Basic NMR components, biological effects,Merits.

UNIT – IV

Critical care Equipment:

Ventilators: Mechanics of respiration, artificial ventilators, Positive pressure ventilator, Types and classification of ventilators. Drug delivery system: Infusion pumps, basic components, implantable infusion system, closed loop control in infusion pump. Cardiac Defibrillators: Need for defibrillators, DC defibrillator, Implantable defibrillators, Defibrillator analyzer.

UNIT – V

Therapeutic Equipment:

Cardiac pacemakers: Need for cardiac pacemakers, External and implantable pacemakers, types. Dialysis Machine: Function of kidney, artificial kidney, Dialyzers, Membranes, Hemodialysis machine. Lithotripters: The stone diseases problem, Modern Lithotripter systems, extra corporeal shockwave therapy.

Suggested Readings:

1. R.S.Khandpur, "*Hand Book of Biomedical Instrumentation"*, Tata McGrawHill, SecondEdition, 2014.
2. John G.Webster, "*Medical Instrumentation Application and design"*, Wiley India Edition,2009.

OE 802CS

DATA SCIENCE USING R

(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To learn basics of R Programming environment: R language, R- studio and R packages
- To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
- To learn Decision tree induction, association rule mining and text mining

Course Outcomes: Student will be able to

1. Use various data structures and packages in R for data visualization and summarization
2. Use linear, non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT- I

Introduction to R: Introduction, Downloading and Installing R, IDE and Text Editors, HandlingPackages in R.

Getting Started with R: Introduction, Working with Directory, Data Types in R, Few Commands for Data Exploration.

Loading and Handling Data In R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment In R, Using 'As' Operator To Change The Structure Of The Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation And Group Processing Of A Variable, Simple Analysis Using R, Methods For Reading Data, Comparison Of R GUI's For Data Input, Using R With Databases And Business Intelligence Systems.

UNIT- II

Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values and Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.

UNIT- III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression? Introduction to Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.

UNIT- IV

Decision Tree: Introduction, What Is a Decision Tree? Decision Tree Representation In R, Appropriate Problems For Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search In Decision Tree Learning, Inductive Bias In Decision Tree Learning, Why Prefer Short Hypotheses, Issues In Decision Tree Learning.

Time Series in R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT- V

Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K-Means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.

Association Rules: Introduction, Frequent Item set, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.

Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, Text Mining Verses Data Mining, Text Mining In R, General Architectures of Text Mining Systems, Pre-Processing of Documents In R, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages.

Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods.Frequent Item set, Closed Item set And Association Rules.

Frequent Item set: Mining Methods, Pattern Evaluation Methods, and Sentiment Analysis

Suggested Readings:

1. Seema Acharya, "*Data Analytics using R",* McGraw Hill education.
2. Nina Zumel and John Mount, "*Practical Data Science with R"*, Manning Shelter Island.
3. Crawley, Michael J., " *The R book",* John Wiley & Sons, Ltd

OE 803EC

MOBILE COMMUNICATION

(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- Understand basics of Cellular systems, their generations and Characteristics of Mobile Communications.
- Understand the Frequency reuse mechanism for Mobile operations and Co-Channel interference concepts
- Understand the Mobile signal Coverage in different terrains and Lee models
- Understand the working of Antennas at Cell-site and at Mobile units.
- Understand the various Handoff mechanisms and Concept of Dropped calls

Course Outcomes: Student will be

1. Able to analyze the various operational features of Mobile Communication Systems
2. Able to deal with the Mobile communication system designs of Frequency re-use and Interference Factors
3. Able to carry out the Design aspects of Mobile signal coverage over different terrains
4. Able to analyze the different Cell-site and Mobile antennas for different applications
5. Able to characterize the Handoffs mechanisms.

UNIT – I

Introduction to Cellular Mobile Communications:

History of Mobile cellular: AMPS system (First-generation systems), Second-generation System, 3G Systems, 4G Systems, 5G Systems, Other Cellular-like Systems, Spectrum allocation, Spectrum Efficiency Considerations.

Basic Cellular systems, Circuit-Switched and Packet-Switched Systems, Performance criteria, Voice quality, Data quality, Picture quality, Service quality and special features.

Uniqueness of Mobile Radio Environment, Description of Mobile Radio Transmission Medium, Model of Transmission Medium, Mobile Fading characteristics, The Radius of Active Scatter region, Delay spread and Coherence Bandwidth, Noise level in Cellular Frequency band

UNIT – II

Frequency Reuse Concept and Cellular system Components:

Concept of Frequency reuse channels, Frequency reuse schemes, Frequency reuse distance, Number of Customers in the System, Co-Channel Interference Reduction Factor, Desired C/I from a Normal case in an Omni-directional antenna System, Handoff mechanism, Cell splitting, Consideration of the Components of Cellular Systems, Antennas, Switching equipment and Data Links.

UNIT – III

Cell Coverage:

General Introduction, Ground Incident angle and Ground Elevation angle, Ground Reflection angle and Reflection point, Obtaining the Mobile Point-to-Point Model (Lee Model), A standard condition,

Obtain Area-to-Area Prediction model, The Phase difference between a direct path and ground-reflected path, A general formula for Mobile Radio Propagation
Propagation over water or Flat open area, Between Fixed stations, Land-to-Mobile transmission over water, Foliage Loss, Propagation in Near-In distance, Long distance propagation, Obtain Path loss from a Point-to-Point Prediction Model in Non-obstuctive condition and obstructive condition, Form of a Point-to-Point Model, General Formula and its Merit

UNIT – IV
Cell-Site and Mobile Antennas:
Antennas at Cell-site, Omnidirectional antennas, Directional antennas, Location antennas, Set-up Channel antennas, Space Diversity Antennas at cell site, Umbrella-Pattern Antennas, Interference reduction antennas, Unique Situations of Cell-Site antennas, Smart antennas, types and applications
Mobile Antennas, Roof-mounted antenna, Glass-Mounted antenna, High-gain antenna, horizontally and vertically oriented Space-Diversity Antennas.

UNIT – V
Handoff and Dropped Calls:
Value of Implementing Handoffs, Types of Handoff, Initiation of Hard Handoff, Delaying a Handoff, Forced Handoffs. Queuing of handoffs, Power difference Handoffs, MAHO and Soft Handoff, Cell-site Handoff only, Intersystem Handoff
Introduction to Dropped Call Rate and Formula of Dropped Call Rate

Suggested Readings:

1. William C.Y.Lee, *"Wireless and Cellular Telecommunications*", 3rd International edition, McGraw Hill, 2006
2. Theodere S. Rappaport, *"Wireless Communications, Principles and Practice*", 2nd edition, Prentice Hall, 2003.
3. Gordon L. Stuber. "*Principles of Mobile Communications",* 3rd edition, Springer Publications, 2011.

OE 804EC

INTERNET OF THINGS AND APPLICATIONS

(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To introduce the concepts of automation in daily life.
- To familiarize the concepts of all IoT based communication systems.
- To understand the importance of cloud technologies in the field of IoT.
- To get familiar with standard embedded boards like Raspberry Pi.
- To study a real time system with a view of an application program interface (API).

Course Outcomes: Student will be

1. Able to design IoT based solutions for given problem statements.
2. Able to develop programs for Raspberry Pi.
3. Able to demonstrate the functionality of cloud communication.
4. Able to analyze the technologies used in IoT.
5. Able to incorporate multiple sensors to develop an IoT based system.

UNIT- I

Introduction to Internet of Things

Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT,IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling TEchnologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and smart Health (Ref1)

UNIT- II

Internet Principles and communication technology

Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source
Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

UNIT- III

API Development and Embedded programming

Getting started with API, Writing a new API, Real time Reactions, Other Protocols, Techniques
for writing embedded code: Memory management, Performance and Battery Life, Libraries, Debugging. Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather Monitoring.

UNIT -IV

IoT Systems - Logical Design using Python

Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages,

File Hnadling, Date/Time Operations., Classes, and Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT- V

Cloud computing and Data analytics and IoT Product Manufacturing

Introduction to Cloud storage models and Communication APIs, Amazon webservices for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT (Ref 1). Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation.(Ref 1) Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

Suggested Readings:

1. Vijay Madisetti , ArshdeepBahga, "*Internet of Things (A Hands-on-Approach)",* VPT Publisher, 1st Edition, 2014
2. Adrian McEwen (Author), Hakim Cassimally", *"Designing the Internet of Things",* Wiley India Publishers
3. Kenneth A Lambert and B.L. Juneja, *"Fundamentals of Python*", Cenage Learning

OE 805EC
GLOBAL AND REGIONAL SATELLITE NAVIGATION SYSTEM
(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To explain the basic principle of GPS and its operation.
- To make the students to understand signal structure.
- To make the students understand the GPS errors.
- Highlight the importance of integrating GPS with other systems.
- To make the students understand about various GRNSS.

Course Outcomes: Student will be

1. Able to understand the principle and operation of GPS.
2. Able to understand the GPS Signal structure and services.
3. Able to understand about various errors.
4. Able to use of GPS in various fields such as navigation, GIS etc.
5. Able to understand principle of Operation of various GRNSS.

UNIT- I

Introduction to Satellites, their properties, Orbits and Launch vehicles, Kepler's Laws, GPS fundamentals: Principle of Trilaiteration, Transit, GPS Operating Principle, And Architecture: Space, Control and User Segments and its Frequencies.

UNIT- II

GPS Signal structure: C/A and P-Codes, SPS and PPS services, GPS Coordinate Systems: Significance, Types of GPS receivers, Selective Availability, Spoofing and Anti-spoofing.

UNIT- III

GPS Errors: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Multipath; Dilution of Precision (DOP).

UNIT- IV

GPS Modernization: Future GPS satellites, New signals and their benefits, New Control Segment, Principle of operation of DGPS, architecture and limitations, GPS Applications: Surveying Mapping Marine, air and land Navigation, Military and Space Application. GPS Integration with Geographic Information System (GIS), Inertial Navigation System (INS), Pseudolite and Cellular.

UNIT- V

Other GRNSS: GLONASS, GALILEO, QZNSS, CNSS and IRNSS System: Principle of Operation, Features and their Current Status.

Suggested Readings:

1. Ahmed El-Rabbany, "*Introduction to GPS"*, Artech House Publishers, 2/e, Boston 2006.
2. Elliot D Kaplan and Christopher J Hegarty," *Understanding GPS principles and applications*", Artech House Publishers, 2/e Boston & London 2005.
3. B.Hofmann-Wellenhof, H.Lichtenegger, and J.Collins, "*GPS Theory and Practice,"* Springer Verlog, 5/e, 2008.

OE 806EE

APPLICATIONS OF ELECTRICAL ENERGY

(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating.
- To understand various techniques of electric welding and types of batteries.
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electric traction including speed – time curves of different traction services.
- To understand systems of train lighting.

Course Outcomes: Student will be

1. Identify a suitable heating scheme for a given application.
2. Identify proper welding technique and various characteristics of batteries.
3. Classify types of electric light sources based on nature and operation and their objectives, performance and reliability.
4. Determine the speed-time characteristics of various traction services and also estimate the energy consumption levels at various modes of operation.
5. Select proper train lighting scheme.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens, Design of heating element. High frequency heating, Induction Heating, Induction furnaces, Core type, Coreless furnaces, Dielectric heating. Electric Arc furnaces, Direct Arc furnace, Indirect Arc furnaces.

UNIT- II

Electric welding: Classification of electric welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

UNIT- III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, Lighting calculations, Determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps, Fluorescent lamp, Starting and power factor corrections, Stroboscopic effects, Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT- IV

Electric Traction: System of Electric Traction, Transmission of drive, Systems of track electrification, Traction mechanics, Speed time curves, Tractive effort, Power of Traction motor, specific energy consumption, Mechanics of train movement, Coefficient of adhesion.

UNIT – V

Train Lighting: Systems of train lighting, special requirements of train lighting, Methods of obtaining unidirectional polarity, Methods of obtaining constant output, Single battery system, double battery parallel block system, Principal equipment of double battery system, Coach wiring, Dynamo.

Suggested Reading:

1. Partab H, *"Art and Science of Utilization of Electric Power",* Dhanpat Rai & Sons, 1997.
2. K.B. Raina & S.K. Bhattacharya, *"Electrical Design, Estimating 1. and Costing*", Wiley Eastern Ltd., 1991.
3. Partab H, "*Modern Electric Traction",* Dhanpat Rai & Sons, 2000.
4. B.L.Theraja, *"A Text Book of Electrical Technology",* S.Chand & Company Ltd, Vol-I.

OE 807ME

COMPOSITE MATERIAL APPLICATIONS

(Open Elective - III)

Instruction: (3L) hours per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- To know the properties of fiber and matrix materials used in composites, as well as somecommon manufacturing techniques.
- To know the various moulding process and architecture of composite laminates
- To know how to estimate the laminate properties from lamina properties.
- To understand the strength of an orthotropic lamina and measurement of basic compositeproperties.

Course Outcomes: Student will be able to

1. Understand the distinction of composites, its advantages, classification and applications
2. Predict the properties of composite lamina and laminate
3. Understand the testing of composites and design the structure using the appropriate design criteria.

UNIT- I

Introduction to composite materials, general characteristics, Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon fibre composites.

UNIT- II

Molding Processes: hand layup, vacuum molding, compression molding, pultrusion molding, centrifugal molding, filament winding, prepegs and molding compounds and architecture of composite materials: laminates, sandwich composites and other architectures.

UNIT- III

Micromechanics of Composites: Mechanical properties: Production of Elastic constant, micromechanical approach, Halpin-Tsal equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT- IV

Macromechanics of Composites: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation

UNIT- V

Strength of an orthotropic lamina: Maximum stress theory, maximum strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials. Measurement of constituent material properties: Fibre tests, Matrix tests. Measurement of basic composite properties: Tensile test, compressive test, a plane shear test, interlaminar shear test, flexure test.

Suggested Readings:

1. Jones, R.M., *"Mechanics of Composite Materials"*, McGraw Hill Co., 1967.
2. Ronald F. Gibson, "*Principles of Composite Materials Mechanics*", McGraw-Hill, Inc.,1994.
3. Krishan, K. Chewla, "*Composite Material*", Springer - verlag, 1987.
4. Carl. T. Herakovich, *"Mechanics of Fibrous Composites*", John Wiley Sons Inc., 1998.

OE 808ME

INDUSTRIAL ADMINISTRATION AND FINANCIAL MANAGEMENT

(Except ECE)

Instructions: (3L) hrs per week *Duration of SEE: 3hours*
CIE: 30 Marks *SEE: 70 Marks*
Credits: 3

Course Objectives:

- To understand various types of organizational structures, manufacturing processes
- Importance of plant layout and the role of scheduling function in optimizing the utilization of resources
- To understand the importance of quality, inventory control and concepts like MRP I and MRP II
- To understand the nature of financial management and concepts like breakeven analysis, depreciation and replacement analysis

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems
2. Role of scheduling function in better utilization of resources
3. Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP –II.
4. Know the different terminology used in financial management and apply different techniques of capital budgeting
5. Analyse and various types of costs involved in running an industrial organization

UNIT-I

Types of organizations, organizational structures. Designing Products, Services and Processes: New product design and development. Product life cycle: phasing multiple products.

Manufacturing process Technology: Product, job shop, batch, assembly line and continuous process technology; flexible manufacturing systems. Design of Services, service process technology operations capacity; capacity planning decisions, measuring capacity; estimating future capacity needs.

UNIT-II

Locating production and services facilities, effects of location and costs and revenues, factor rating, simple median model (linear programming) Layout planning; process layout; product layout — Assembly lines; line balancing manufacturing cellular layout. Scheduling systems and aggregate planning for production and services; loading assignment algorithm; priority sequencing and other criteria.

UNIT-III

Quality planning and Control: basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. Economics of quality and measurement of the cost of quality. Quality considerations in design. Process control: machine and process capability analysis. Use of control charts and process engineering techniques for implementing the quality plan. Acceptance sampling: single, double and multiple sampling, operating characteristic Curve - calculation of producers risk and consumers risk.

UNIT-IV

Inventory control: deterministic and stochastic inventory models; variable demand; lead time, specific service level, perishable products and service. Inventory control in application; concepts for the practioners; saving money in inventory systems; ABC classifications. Inventory control procedures; Quantity - reorders versus periodic inventory systems; material requirement planning (MRP); MRP as a scheduling and ordering system; MRP system components; MRP computational procedure; Detailed capacity planning; MRP - limitation and advantages; Manufacturing Resources Planning (MRP-II).

UNIT-V

Elements of cost, overheads, breakeven analysis, depreciation, replacement analysis. Nature of financial management-time value of money, techniques of capital budgeting and method, cost of capital, financial leverage.

Suggested Reading:

1. Buifa and Sarin, *"Production and operations management*" - Wiley Publications.
2. I.M. Pandey, *"Elements of Financial Management"* Vikas Publications, New Delhi, 1994.
3. James C. Van Home & John, M. Wachowicz, Jr., *"Fundamentals of Financial Management*", Pearson Education Asia, 11 Th ed. 2001.

OE809CS

SOFTWARE ENGINEERING

(Open Elective - III)

Instruction: 3L hrs per week *Duration of SEE : 3 hours*
CIE : 30 Marks *SEE : 70 Marks*
Credits:3

Course Objectives:

- To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product
- To impart knowledge on various phases , methodologies and practices of software development
- To understand the importance of testing in software development and study various testing strategies and software quality metrics

Course Outcomes:

Student will be able to

1. Acquire working knowledge of alternative approaches and techniques for each phase of software development
2. Acquire skills necessary for independently developing a complete software project
3. Understand the practical challenges associated with the development of a significant software system

UNIT-I
Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models.

UNIT-II
Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.
System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.
Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT-III
Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT-IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design, Assessing Alternative Architectural Designs, Mapping Data Flow into a Software Architecture.

Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-V

Software Quality Assurance: Basic Elements, Tasks, Goals and Metrics, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO 9000 Quality Standards, SQA Plan.

Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for O-O Software, Validation Testing, System Testing, The Art of Debugging.

Testing Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods, Testing Methods applicable on the Class Level, Inter Class Test Case Design, Testing for Specialized Environments, Architectures and Applications, Testing Patterns.

Product Metrics: Software Quality, A Framework for Product Metrics, Metrics for the Analysis Model, Metrics for the Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

Suggested Readings:

1. Roger S.Pressman," *Software Enigneering: A Practitioner's Approach*", 7th Edition, McGraw Hill, 2009.
2. Ali Behforooz and Frederick J.Hudson, "*Software Engineering Fundamentals*", Oxford University Press, 1996.
3. Pankaj Jalote , "*An Integrated Approach to Software Engineering*", 3rd Edition, Narosa Publishing House, 2008.

OE810CS **PYTHON PROGRAMMING**

(Open Elective - III)

Instruction: 3L hrs per week *Duration of SEE : 3 hours*
CIE : 30 Marks *SEE : 70 Marks*
Credits:3

Course Objectives:
The main objective is to teach Computational thinking using Python.

- To know the basics of Programming
- To convert an algorithm into a Python program
- To construct Python programs with control structures.
- To structure a Python Program as a set of functions
- To use Python data structures-lists, tuples, dictionaries.
- To do input/output with files in Python.
- To construct Python programs as a set of objects.

Course Outcomes:
On completion of the course, students will be able to:

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Develop simple Python programs for solving problems.
4. Structure a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries.
6. Read and write data from/to files in Python Programs

UNIT-I
Introduction to Computing and Problem Solving: Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms.
Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language.
Control Flow Statements: The if, The if…else,The if…elif…else Decision Control Statements, Nested if Statement, The while Loop, The for Loop, The continue and break Statements.

UNIT-II
Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, Command Line Arguments.
Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT-III

Files and exception: text files, reading and writing files, format operator; command line arguments,errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings

Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT-IV

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance The Polymorphism.

Functional Programming: Lambda. Iterators, Generators, List Comprehensions.

UNIT-V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Suggested Readings:

1. Richard L. Halterman, " *Learning To Program With Python*", Copyright © 2011.
2. Dr. Charles R , "*Python for Everybody, Exploring Data Using Python 3*", Severance. 2016.
3. Gowrishankar S., Veena A, "*Introduction to Python Programming*", CRC Press, Taylor & Francis Group, 2019.
4. Allen B. Downey, ``*Think Python: How to Think Like a Computer Scientist*'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

OE811CS

CYBER SECURITY

(Open Elective - III)

Instruction: 3L hrs per week *Duration of SEE : 3 hours*
CIE : 30 Marks *SEE : 70 Marks*
Credits:3

Course Objectives:

- Understand the threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and it applications.

Course Outcomes:

After Completion of the course, Student will be able to:

1. Understand the various network threats
2. Analyse the forensic tools for evidence collection
3. Apply the firewalls for threat analysis

UNIT-I

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering.

UNIT-II

Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis.

UNIT-III

Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, searc and seizure of computer systems, password cracking

UNIT-IV

Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrival, Email analysis from mobile phones.

UNIT-V

Ethics, Policies and IT Act

Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, E Commerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems

Indian Laws, Information Technology Act 2000, Indian Evidence Act, India Technology Amendment Act 2008, Indian Penal Code , Computer Security Act 1987, National Information Infrastructure Protection Act 1996, Fraud Act 1997, Children Online Protection Act 1998, Computer Fraud and Abuse Act 2001, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship, Introduction to Cyber Ethics, rights over intellectual property, Corporate IT Policy Formulations, Compliance Auditing.

Suggested Readings:

1. Charles P. Fleeger, "*Security in Computing*", Prentice Hall, New Delhi, 2009.
2. BehrouzA.Forouzan, "*Cryptography & Network Security*", Tata McGraw Hill, India, New Delhi, 2009.
3. William Stallings, "*Cryptography and Network Security*", Prentice Hall, New Delhi, 2006.
4. Chalie Kaufman, Radia Perlman, Mike Speciner, "*Network Security: Private Communication in a Public Network*", Pearson Education, New Delhi, 2004.
5. Neal Krawetz, "*Introduction to Network Security*", Thomson Learning, Boston, 2007.
6. Bruce Schneier, "*Applied Cryptography*", John Wiley & Sons, New York, 2004.

PW 851EC

MAJOR PROJECT PHASE - II

Instruction: 12 weeks *Duration of SEE: 3 hours*
CIE: 50 marks *SEE: 100 marks*
Credits: 6

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

1. demonstrate the ability to synthesize and apply the knowledge and skills acquired in theacademic program to real-world problems
2. evaluate different solutions based on economic and technical feasibility
3. effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of project work –II is to implement and evaluate the proposal made as part of project – I. Students can also be encouraged to do full time internship as part of project work-II based onthe common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of inters hip candidates from groups made as partof project work-I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1nd week of VIII^{t} semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

PW 852EC

SELF STUDY PROJECT

Instruction: 4 hours per week *Duration of SEE:*
CIE: 50 marks *SEE:*
Credits: 2

Course Objectives:

- Understanding real life problems
- Problem solving techniques
- Working independently
- Drawing conclusions from analysis
- Date interpretation & presentation skills

Course Outcomes: Student will be able to

1. Use of library, literature review
2. Hunting/ Understanding the problem of social relevance / practical importance
3. Learn data analysis/ synthesis
4. Learn to choose right path/ optimum solutions
5. Lear presentation (Oral/technical/professional writing skills)

Procedure:

1. Student will choose problem on his/her own depending on his/her interest
2. Department will designate one coordinator in each semester for this course
3. Student will choose on their own, their mentor, who can be from department/ from other department or outside college (from industry/National organisations)
4. Topic need not be in ECE. It can be from any discipline but should have social relevance/practical importance.
5. Student will carry out work on his/her own by carrying out systematic literature survey, data/information collection, hence identify the problem.
6. Analyse/synthesis the data/information, choose proper tool/technique to solve the problem.
7. Should be able to interpret data and draw concrete conclusions.
8. Should write professional/technical report (Max. 50 pages per semester) giving all details, references, conclusion, and scope for future work, underline importance of the work carried out.
9. Will present his work before mentor/HOD/one examiner (from sister department)
10. Marks to be awarded by examining report and performance in defence (Viva) to be conducted by mentor and external examiner (from other department)

Self-Study project will be carried out independently by each student (not in group). If a single big problem is identified, three or four students can attempt, but activity of each student will be separate, report will be separate.