# MCKV INSTITUTE OF ENGINEERING

NAAC Accredited "A" Grade Autonomous Institute under UGC Act 1956
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## Curriculum for Undergraduate Degree (B.Tech.) in Electronics and Communication Engineering (w.e.f. AY: 2020-21)

## Part III: Detailed Curriculum

## Seventh Semester

| | | | |
|---|---|---|---|
| **Course Name**: | **Microwave Theory and Techniques** | | |
| **Course Code**: | PE-EC701A | **Category:** | Professional Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Basic Knowledge of Electromagnetics and Transmission Lines |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To understand Mathematical model of Microwave Transmission. |
| 2 | To characterize the Microwave systems using Scattering Parameters. |
| 3 | To understand the basic principles of Microwave Active and passive devices. |
| 4 | To carryout the design of Microwave Impedance matching networks, Filters, and Amplifiers. |
| 5 | To understand the principles of measurement of various circuit parameters |

**Course Contents:**

| Module No. | Description of Topic | Contact Hrs. |
|---|---|---|
| 1 | **Introduction to Microwaves**- History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil, Military and Medical applications.<br>**Mathematical Model of Microwave Transmission**-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission. Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Micro strip line, Coplanar waveguide, Slot line-design consideration, field patterns, propagation Characteristics. Microwave Integrated Circuits MIC and MMIC. | 1<br>8 |
| 2 | **Microwave Network Analysis**- Network parameters for microwave circuits, Scattering Parameters. | 3 |

| | | |
|---|---|---|
| 3 | **Passive and Active Microwave Devices**- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonators. Microwave Semiconductor Devices: Gunn Diode, IMPATT diode, Tunnel diode, Schottky Barrier diode, PIN diode. Microwave Tubes: Klystron, Magnetron, TWT. Non-Reciprocal devices i.e. Isolator, Circulator, Gyrator. | 10 |
| 4 | **Microwave Design Principles**-Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design. | 6 |
| 5 | **Microwave Antennas**-Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas. | 4 |
| 6 | **Microwave Measurements**- Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. | 4 |
| 7 | **Microwave Systems**- Elementary discussion on Radar, Terrestrial and Satellite Communication, RFID,Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC). | 4 |
| **Total** | | **40** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Analyze the Mathematical model of Microwave Transmission i.e concept of Modes, Impedances. |
| 2 | Characterize the Microwave systems using Scattering Parameters. |
| 3 | Define the basic Principles and Characteristics of different Microwave Passive and Active Devices. |
| 4 | Carryout design of Microwave Impedance matching networks , Filters, and Amplifiers. |
| 5 | State the principles of measurement of various circuit parameters like power, frequency, impedance at microwave frequency range. |

| **Learning Resources:** | |
|---|---|
| 1 | Microwave Engineering, 3rd ed David M. Pozar, Willey & Sons Inc. |
| 2 | Microwave Devices & Circuits, SY Liao , Pearson Education /PHI |
| 3 | Foundations of Microwave Engineering, R. E. Collin, McGraw Hill |
| 4 | Microwave Devices & Circuit Design , G.P Srivastava & VL Gupta, PHI |
| 5 | Microwave Engineering-Passive Circuits, PA Rizzi , Pearson Education. |

| | | | |
|---|---|---|---|
| **Course Name**: | **Error Correcting Codes** | | |
| **Course Code**: | PE-EC 701B | **Category:** | Professional Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Information Theory and coding |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To understand the basic concept linear block codes and maximum likelihood decoding |
| 2 | To understand Basic finite field theory for algebraic codes and its operation |
| 3 | To Explain Cyclic, BCH and Reed-Solomon code operation |
| 4 | To Develop Low Density Parity Check Codes |

**Course Contents:**

| Module No. | Description of Topic | Contact Hrs. |
|---|---|---|
| 1 | **Introductory Concepts**: Noisy channels, Block Codes, Encoding and Decoding, Maximum likelihood decoding, Minimum distance decoding, Error detection and correction, Shanon Noisy channel coding theorem | 03 |
| 2 | **Linear Codes:** Minimum distance and Hamming codes, Generator and Parity Check matrix, standard array decoding, Syndrome decoding, Repetition codes, Error matrix, Dual codes | 03 |
| 3 | **Basic Finite Field Theory:** Binary Field Arithmetic, Construction of prime power field via irreducible polynomial, Existence of primitive elements, Minimal Polynomials | 04 |
| 4 | **Cyclic Codes**: Description of Cyclic Codes, Encoding of cyclic codes, Generator and Parity check polynomials, Cyclic Hamming Codes, Syndrome Computation and Error Detection, Error trapping decoding, Shortened cyclic codes | 04 |
| 5 | **BCH and Reed- Solomon codes:** Binary primitive BCH Codes, Iterative algorithm for finding the error-location polynomial, Identification of error location numbers and error correction, Implementation of Galois Field Algorithm, Weight distribution and error detection of Binary BCH Codes, Reed-Solomon codes | 08 |
| 6 | **Convolution Codes**: .Encoding of convolution code, Structural properties, Code trellis, Code tree, state diagram Viterbi decoder, catastrophic error propagation | 05 |
| 7 | **Turbo Coding:** Introduction to Turbo coding, Distance properties of Turbo codes, performance analysis and design of Turbo Codes | 04 |

| | | |
|---|---|---|
| 8 | **Low Density Parity Check (LDPC) Codes:** Introduction to LDPC Codes, geometric construction of LDPC codes, Tanner Graphics, Iterative message-passing decoding algorithms, Decoding of LDPC codes | 05 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Explain Linear Block codes, Hamming Distance |
| 2 | Design of simple cyclic encoder and Decoder circuits |
| 3 | Generates Different types of convolution codes. |
| 4 | Analyze suitable coding mechanism for intelligent signal transmission |

| **Learning Resources:** | |
|---|---|
| 1 | Shu Lin and Daniel J Costello Jr.- Error Control Coding, 2 Edition, Pearson |
| 2 | R.M. Roth- Introduction to Coding Theorey, Cambridge university press |
| 3 | W.C. Huffman and V. pless – Fundamental of Error correcting Codes, Cambridge university press |

| **Course Name**: | **Industrial Automation and Control** | | |
|---|---|---|---|
| **Course Code**: | PE-EC701C | **Category:** | Professional Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Control System PC-EC601 and Digital System Design PC-EC402 |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To impart basic concept of different control modes. |
| 2 | To identify different components of an automation system |
| 3 | To prepare a PLC program for a given application and interface. |
| 4 | To provide an overall exposure to the technology of Industrial Automation and Control. |
| 5 | To maintain Industrial Automation Systems. |
| 6. | To discusses a wide range of related topics from the advantage and architecture of automation systems. |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **Introduction to Industrial Automation and Control**:<br>Introduction to Industrial Automation, Requirement of Automation Systems, Architecture of Industrial Automation Systems. General review of process, Process control & automation, Servo and regulatory control, Characteristic parameter of a process: Process quality, Process potential, Process resistance, Process capacitance, Process lag, Self-regulation. Introduction to Industry 4.0 and Industry 5.0 . | 6 |
| 2 | **Different Control Modes and Implementation:**<br>On-off control, Multistep, Time proportional, Proportional, Proportional-integral, Proportional -derivative, Proportional-integral-derivative, integral windup, bump less transfer, Inverse derivative control, controller tuning techniques and selection guideline. Implementation of PID Controllers. | 6 |
| 3 | **Advance Industrial control strategies (Brief analysis):**<br>Feedforward control, Cascade control, Ratio control, Selective Control, Split Range Control, Adaptive control. | 6 |
| 4 | **Actuators and final control elements:**<br>Classification of Actuators: pneumatic, hydraulic, electro-pneumatic, and stepper motor operated actuators. Pumps and motors, proportional and servo valves. | 4 |
| 5 | **Automation using relay logic:**<br>Relay Circuits: Construction & Principle of Operation, Types of Relays, Relay as a memory element, Contactor Circuits, Advantages of Contactors over Relay, DOL circuit implementation using contactor, Automation problems based on relays | 4 |
| 5 | **Automation using Programmable Logic Controller:**<br>PLC Introduction: History & Current Trends, Basic Block Diagram of PLC, Classification of PLCs, Block diagram, Basic Architecture and Functions; Input-Output Modules, power supply. PLC Programming: Relay logic and ladder logic, PLC ladder diagram realization, Sequential flow Chart, PLC Timer, PLC Counter, advance instructions. PLC programming examples for Industrial maintenance and control. Introduction to PLC and supervisory control and data acquisition (SCADA). Industrial communication protocols: modbus & profibus. | 6 |
| 6 | **Distributed Control System (DCS):**<br>Basic concept and overview of DCS, DCS System Architecture, configuration, operation and features. HMI and SCADA, OSI Communication Standard and Fieldbus. | 4 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Understand the concept of automation, its terminology and basic communication protocol |
| 2 | Apply Relay logic for automation |
| 3 | Learn about PLC, its operation and application in automation |
| 4 | Analyze the industrial sensors, its terminology and how one can interface with PLC. |
| 5 | Demonstrate Pneumatic system and its application in industry. |

| **Learning Resources:** | |
|---|---|
| 1 | Industrial Instrumentation and Control, by Singh, McGraw Hill |
| 2 | Programmable Logic Controllers with Control Logix, by Jon Stenerson, Delmar Publishers, 2009 |
| 3 | Webb John W. and Reis A. Ronald, "Programmable Logic Controllers Principles and Applications" PHI ,New Delhi, Latest edition |
| 4 | Bolton W, "Programmable Logic Controllers" Elsevier India Pvt. Ltd. New Delhi |
| 5 | B. Pneumatic Systems-Principles and Maintenance Mazumdar S. R |
| 6 | John R Hackworth, "Programmable Logic Controllers" Pearson education New Delhi, Latest edition |

| **Course Name**: | **Embedded System** | | | |
|---|---|---|---|---|
| **Course Code**: | PE-EC702A | **Category:** | Professional Elective | |
| **Semester**: | Seventh | **Credit:** | 3 | |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Computer Architecture and Operating Systems | |
| **Full Marks:** | 100 | | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 | |

| **Course Objectives:** | |
|---|---|
| 1 | Illustration of different embedded system and its purpose. |
| 2 | Describe the concepts of different architecture required for an embedded system |
| 3 | Impart the knowledge of different components required for an embedded system |
| 4 | To develop an insight about the Program Modeling Concepts and Real time Operating system concepts for design of an simple embedded systems |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | Introduction to Embedded System: Introduction to Embedded Systems and Computer Systems Terminology. Embedded system vs General computing systems, History of Embedded systems, Purpose of Embedded systems. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply. Microprocessor and Microcontroller, Hardware architecture of the real time systems. | 8 |
| 2 | Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance. Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems. Introduction to Architecture of ARM and MSP430 | 10 |
| 3 | I/o types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. | 8 |
| 4 | Program Modeling Concepts: Fundamental issues in Hardware software co-design, Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system. Circuit Prototyping techniques. Designing of a custom Processor | 8 |
| 5 | Real Time Operating Systems : Different types of RTOS, Qualities of Good RTOS Real time Scheduling Algorithms Rate monotonic, Earliest Deadline First ( EDF). | 6 |
| **Total** | | **40** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Describe about different embedded system and its purpose. |
| 2 | Explain the different architecture required for an embedded system |
| 3 | Analyze the different components required for an embedded system |
| 4 | Apply the Program Modeling Concepts and Real time Operating system concepts for design of an simple embedded system |

| **Learning Resources:** | |
|---|---|
| 1 | Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X |
| 2 | Embedded Systems: An Integrated Approach LyLa B. Das,Pearson Education India, 2012, ISBN 9332511675, 9789332511675 |
| 3 | Intro To Embedded Systems , Shibu, McGraw-Hill Education (India) Pvt Limited ISBN 007014589X, 9780070145894 |
| 4 | Embedded systems: architecture, programming and design ,Raj Kamal ,McGraw-Hill, 2003 ISBN 0070494703, 9780070494701 |
| 5 | Embedded System Design, SantanuChattopadhyay, PHI Learning (2/e) |

| **Course Name**: | **Wireless Sensor Networks** | | |
|---|---|---|---|
| **Course Code**: | PE-EC702B | **Category:** | Professional Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Computer Network (PC-EC602) |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To design wireless sensor networks for a given application |
| 2 | To understand emerging research areas in the field of sensor networks |
| 3 | To understand MAC protocols used for different communication standards used in WSN |
| 4 | To explore new protocols for WSN |

| **Course Contents:** | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks | 4 |

| | | |
|---|---|---|
| 2 | Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks | 4 |
| 3 | Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, BMAC protocol, IEEE 802.15.4 standard and ZigBee | 6 |
| 4 | Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols. | 6 |
| 5 | Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication | 6 |
| 6 | Single-node architecture, Hardware components & design constraints, | 5 |
| 7 | Operating systems and execution environments, introduction to TinyOS and nesC. | 5 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Design wireless sensor networks for a given application. |
| 2 | Understand and demonstrate emerging research areas in the field of sensor networks. |
| 3 | Understand MAC protocols used for different communication standards used in WSN and implement it under constrained environment. |
| 4 | Explore new protocols for WSN. |

| **Learning Resources:** | |
|---|---|
| 1 | Waltenegus Dargie , Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications, 2011 |
| 2 | Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication, 2009 |
| 3 | Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications, 2004 |
| 4 | Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science |
| 5 | Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press, 2009 |

| **Course Name**: | **Renewable Energy** | | |
|---|---|---|---|
| **Course Code**: | PE-EC702C | **Category:** | Professional Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Basic knowledge of Electronics, Mechanics and Electrical engineering |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| Course Objectives: | |
|---|---|
| 1 | To have an idea about different sources of renewable energy that would be sustainable. |
| 2 | To introduce students with renewable energy resources availability, potential and suitability as a substitute for conventional energy resources in future energy demand |
| 3 | To facilitate the students to achieve a clear conceptual understanding of technical aspects of different renewable Sources of Energy |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **Classification of Energy Sources:** Advantages of Non-Conventional Energy Sources over Conventional Sources Economics, Impact on Environment, Electricity Generation from Non-Conventional Energy Sources: | 2 |
| 2 | **Solar Energy:** Solar radiation and its Characteristics, Principles of Solar Collectors: flat Plate, focusing, Solar Energy use for water heating, Solar thermal power generation, and Hybrid solar power.<br>Principle of energy conversion in solar cells, Photovoltaic, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems. | 10 |
| 3 | **Wind Energy:** Wind as energy source, expression for power development because of wind, Design of Wind turbine, Selection of site of Wind farm, characteristics of different types of wind generators used with wind turbines | 6 |
| 4 | **Hydel Energy:** Electricity generation from micro hydel plants, location, auxiliaries and associated problems | 3 |
| 5 | **Biomass Energy:** Resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier. co-generation, Bio diesel: Sources, usability and advantages over mineral product | 3 |
| 6 | **Ocean Energy:**<br>Tidal Energy: Principle, selection of site, Economics and future prospect<br>Wave Energy: Principle , selection of site and future prospect | 4 |
| 7 | **Geo thermal Energy:** Principle , location , economics and prospect | 2 |
| 8 | **Fuel Cells:** Principle of fuel cells, Different types of fuel cells, advantages and limitations, | 2 |
| 9 | **Magneto hydrodynamics energy conversion:** Principle, Economics and environmental aspect of MHD generation | 2 |
| 10 | **Smart Grid :** Concept of Smart Grid | 2 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Discuss the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment. |
| 2 | Describe the basics of solar energy and use of solar energy for heating as well as photovoltaic generation. |
| 3 | Identify Winds energy as alternate form of energy and to know how it can be tapped |
| 4 | Explain the principle of generation and use of different renewable energy sources such as ocean energy, hydel energy, geothermal energy, biomass energy, magneto hydrodynamics energy conversion etc. |

| **Learning Resources:** | |
|---|---|
| 1 | B.H. Khan " Non-Conventional Energy Resources", McGraw-Hill Education |
| 2 | G. Boyle, Renewable Energy, 2nd Edition, Oxford University Press, 2010. |
| 3 | J. Twidell and T. Weir, Renewable Energy Resources, 2nd Edition, Taylor & Francis, 2006 |
| 4 | Solar Energy: Fundamentals, Design, Modelling and Applications by G. N. Tiwari |

| **Course Name**: | **Adaptive Signal Processing** | | |
|---|---|---|---|
| **Course Code**: | OE-EE701A | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Digital Signal Processing PC-EC504 and Linear Mathematics |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To impart basic concept of Adaptive Process. |
| 2 | To impart knowledge about various adaptive signal processing algorithms and many applications. |
| 3 | To understand current applications for adaptive systems in different fields |
| 4 | To understand a comprehensive treatment of mathematical signal processing algorithms for designing optimum and linear filters. |
| 5 | To develop an insight into the construction and working of adaptive filters and its applications. |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **Discrete random processes**:<br>Review of probability, Random variables, random processes, filtered random processes, Ensemble averages, correlation, covariance, power spectrum, cross power spectrum, Ergodicity, time averages, biased & unbiased estimators, consistent estimators. | 6 |
| 2 | **Introduction to Adaptive Systems:**<br>General concept of adaptive filtering and estimation, applications and motivation, , random variables and stationary random processes, Correlation structures, properties of correlation matrices. | 6 |
| 3 | **Digital Wiener filtering:**<br>Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustmen | 6 |
| 4 | **LMS Algorithm & Applications:**<br>Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, blocks LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces. | 8 |
| 5 | Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with Autoregressive model (AR) modeling, joint process estimator, gradient adaptive lattice. | 6 |
| 6 | **State Estimators:**<br>Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array | 8 |
| **Total** | | **40** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation |
| 2 | Mathematically represent the 'adaptability requirement'. |
| 3 | Understand the mathematical treatment for the modeling and design of the signal processing systems. |

| **Learning Resources:** | |
|---|---|
| 1 | S. Haykin, Adaptive filter theory, Prentice Hall, 1986 |
| 2 | C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984. |
| 3 | Tu¨lay Adalı ,Simon Haykin," Adaptive Signal Processing", John Wiley & Sons |
| 4 | Bernard Widrow, Samuel D.Strearns, "Adaptive Signal Processing", 2005, PE |
| 5 | Adaptive Filters: Structures, Algorithms and Applications, M. Honig, D. Messerschmitt, Kluwer, 1984. |
| 6 | Adaptive Signal Processing: Next-Generation Solutions, Tulay Adali and Simon Haykin, Wiley-India edition, 2010 |

| **Course Name**: | **Digital Image and Video Processing** | | |
|---|---|---|---|
| **Course Code**: | OE-EE701C | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Mathematics-I (BS-M101)<br>Mathematics-II (BS-M201) |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To mathematically represent the various types of images and analyze different parameters of them. |
| 2 | To process an image for the enhancement of certain properties or for optimized use of the resources in spatial and frequency domains. |
| 3 | To develop algorithm for image compression and coding both for still and video images. |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | Digital Image Fundamentals- Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels - neighborhood, adjacency, connectivity, distance measures. | 4 |
| 2 | Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters - linear and order-statistics, pixel-domain sharpening filters - first and second derivative, two-dimensional DFT and its inverse, frequency domain filters -low-pass and high-pass. | 6 |
| 3 | Color Image Processing-Color models-RGB, YUV, HSI; Color transformations- formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. | 4 |
| 4 | Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding - global and adaptive, region-based segmentation. | 4 |
| 5 | Morphological Image Processing: Introduction, Dilation, Erosion, Opening, closing, Hit-or-miss transformation, Morphological algorithm operations on binary Images, Morphological algorithm operations on gray-scale Images. | 4 |
| 6 | Image Compression-Redundancy-inter-pixel and psycho-visual; Lossless compression - predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards-JPEG and JPEG-2000. | 4 |
| 7 | Fundamentals of Video Coding-Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification - I, P and B; Video sequence hierarchy-Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards - MPEG and H.26X. | 6 |
| 8 | Video Segmentation-Temporal segmentation-shot boundary detection, hard-cuts and soft-cuts; spatial segmentation-motion-based; Video object detection and tracking. | 4 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Mathematically represent the various types of images and analyze them. |
| 2 | Process an image for the enhancement of certain properties or for optimized use of the resources. |
| 3 | Develop an algorithm for image compression and coding. |

| **Learning Resources:** | |
|---|---|
| 1 | R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008 |
| 2 | Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004 |
| 3 | Murat Tekalp, Digital Video Processing, Prentice Hall, 2nd edition 2015 |

| **Course Name**: | **Neural Network and Fuzzy Logic Control** | | |
|---|---|---|---|
| **Course Code**: | OE-CS701G | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | BS-M101, BS-M201, BS-M301 |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To explore the evolution of ANN starting from its initial phase |
| 2 | To learn the structure and function of ANN |
| 3 | To analyze ANN learning and applications |
| 4 | To explore Fuzzy Logic control and applications |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **Introduction:** Biological Neural Network and Artificial Neural Network (ANN), McCulloch-Pitts Neuron, Perceptron, Perceptron Learning Algorithm and Pattern classification using perceptron, Perceptron function vs Sigmoid or Logistic function, Sigmoid Neuron. | 6 |
| 2 | **Structural and Functional framework of ANN**: Feedforward Neural Networks: Activation Functions-Hidden Layer, Activation Functions- Output Layer, Multilayer feedforward neural networks with example. | 6 |
| 3 | **ANN Learning and Applications**: Approximation of any arbitrary function, Error or Loss Function- Mean Square and Cross Entropy, Learning Algorithm-Minimization of Loss, Gradient Descent, Backpropagation of error with example, Optimizers, Learning Rate, Overfitting and Underfitting, L1 and L2 Regularization, Dropout, Early Stopping, Augmentation. ANN Tools and Applications. | 9 |
| 4 | **Fuzzy Logic Control**: Fuzzy vs. Crisp, Set, Venn Diagram, Cardinality, Null Set, Singleton Set, Power Set, Crisp and Fuzzy Set Properties, Membership Functions, Fuzzy Relations, Fuzzy Composition- Max-Min Composition and Max-Product Composition with examples, Tolerance and equivalence relations, Fuzzification, Membership value assignments, Fuzzy to crisp conversions, Lambda cuts for fuzzy sets and relations, Defuzzification methods. | 6 |
| 5 | **Fuzzy Logic and Applications:** Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models – Sugeno Fuzzy Models. Fuzzy Logic Tools and Applications. | 9 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Comprehend the concepts of McCulloch-Pitts neuron and perceptron |
| 2 | Describe structural and functional framework of ANN |
| 3 | Comprehend ANN learning procedure and applications |
| 4 | Discuss Fuzzy Logic control and applications |

| Learning Resources: | |
|---|---|
| 1 | Neural Networks and Fuzzy Logic Paperback – Dr. R.P. Das, L. Sreedhar<br>S.K. Kataria & Sons |
| 2 | Neural Networks and Learning Machines, Simon S. Haykin, Prentice Hall. |
| 3 | Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications<br>S. Rrajasekaran · G. A. Vijayalakshmi Pai<br>PHI Learning Pvt. Ltd. |
| 4 | S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Wiley Publication. |
| 5 | https://cdn.preterhuman.net/texts/science_and_technology/artificial_intelligence/Neural%20Networks%20-%20A%20Comprehensive%20Foundation%20-%20Simon%20Haykin.pdf |

| **Course Name**: | **Big Data Analytics** | | |
|---|---|---|---|
| **Course Code**: | OE-CS701A | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | DBMS, JAVA, PYTHON |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| Course Objectives: | |
|---|---|
| 1 | To learn the concepts of Big Data and Hadoop |
| 2 | To understand and apply the concept of HDFS and MapReduce |
| 3 | To deal with Big Data using Hive, Pig, HBase, Impala, Sqoop |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | Introduction to big data: Variety of Big Data. Big Data and its Importance of 3 V's, 4 V's, 6 V's of Big Data, Characteristics' of Big Data.<br>Introduction of Hadoop, Benefit of Hadoop, Core Components of Hadoop, Other Components of Hadoop, Hadoop Cluster, Hadoop Start-up Mode. Introduction to HDFS, Architecture of HDFS, Role and types of Name Node, HDFS Commands. | 12 |
| 2 | Introduction to MapReduce, Flow of Map Reduce, Word Count Problem by Using Map Reduce etc. | 4 |

| | | |
|---|---|---|
| 3 | Introduction to Hive, Architecture of Hive, Data Types of Hive, Hive Query language, Handling Complex Data Types, Scripting in Hive, Different join operations on database tables. Introduction to PIG, Data Types in Pig, Pig Latin, Scripting in Pig. | 10 |
| 4 | Introduction to Sqoop, import data from HDFS To MySQL, Import data From Hive to MySQL. Exporting Data from Hive to Mysql. | 4 |
| 5 | Introduction to NoSQL, Types of NoSQL Databases. Introduction to HBase. Introduction to Impala. | 6 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Describe the concept of Big Data, Hadoop and HDFS |
| 2 | Describe the concept of Map Reduce, Hive, HBase, Pig, Sqoop and Impala |
| 3 | Demonstrate the concept of data transfer between HDFS, MySQL and Hive. |
| 4 | Apply NoSQL for importing and exporting unstructured data |

| **Learning Resources:** | |
|---|---|
| 1 | Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013. |
| 2 | DT Editorial Services, "Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Dreamtech Press India Pvt. Ltd., 2020 |
| 3 | Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. |
| 4 | Rajkumar Buyya, "Big Data Principles and Paradigms", MK |
| 5 | Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly, 2012. |
| 6 | Lars George, "HBase: The Definitive Guide", O'Reilley, 2011 |
| 7 | Alan Gates, "Programming Pig", O'Reilley, 2011. |
| 8 | Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons,2014 |

| | | | |
|---|---|---|---|
| **Course Name**: | **Web Technology** | | |
| **Course Code**: | OE-IT701F | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | ES-CS201(Programming for Problem Solving) |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To learn the basic tags of HTML. |
| 2 | To learn the principles of Object Orientated Programming. |
| 3 | To build an application using Java standalone application & Java applet |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | Web Development: HTML, Structure, Tags, Lists, Table, Link and it's types ,Images, Form, Frame, Style sheets and it's type | 4 |
| 2 | Introduction to Java: Java and Java applications, Java Virtual Machine(JVM), Java Runtime Environment(JRE)Java Development Kit(JDK,) Byte code, Java characteristics, Object oriented Programming, Simple java programs, Data types, Operators, Expressions, control statements, Selection statements, Iteration statements, Jump statements | 4 |
| 3 | Classes, Inheritance : Classes in java, Declaring a class, Creating instances of class, Constructors, Argument Passing, use of static keyword, Innner class. Method overloading, Inheritance, use of super keyword ,Method overriding, Abstract class, Dynamic method dispatch, use of final keyword | 5 |
| 4 | Interface, Package: Package, Access control mechanism, Interface, Dynamic Method look up | 2 |
| 5 | Exception Handling: Java Exception Handling Mechanism, try, catch, throw, throws and finally, Exception types, Built in Exceptions: checked and unchecked exceptions, User defined Exceptions | 4 |
| 6 | String Handling: String and String Buffer, Constructors, String operations : character extractions, String comparisons, searching, strings, modifying a string. To String() and valueOf() methods, String Buffer operations | 2 |
| 7 | Java I/O Stream: I/O basics, Byte stream, Character stream, Reading console input, Writing console output, Reading and writing files | 2 |
| 8 | Java Utility package: Collection overview, Collection interfaces, Collection classes: ArrayList, LinkedList, Accessing a collection using, iterator and for-Each statement | 4 |
| 9 | Applet: Applet class, Applet architecture, Applet Skeleton, Life cycle methods, setForeground() and set Bachground()methods, Using the status window,HTML Applet tag, Passing parameters to an applet, GetCodebase() and Get Documentbase() methods. | 4 |
| 10 | Event Handling and AWT: Delegation Event Model, Event classes, Sources of Events, Event Listener interfaces,Event handling using adapter class, Inner and anonymous class, AWT classes: Label,Button,TextField etc. | 4 |
| | **Total** | **35** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to | |
| 1 | design good web pages using different tags, tables, forms, frames and style sheets supported by HTML. |
| 2 | implement, compile, test and run Java programs, comprising more than one class, to address a particular software problem. |
| 3 | demonstrate the ability to employ various types of selection statements and iteration statements in a Java program. |
| 4 | be able to leverage the object-oriented features of Java language using abstract class and interface. |
| 5 | be able to handle errors in the program using exception handling techniques of Java. |
| 6 | design applets as per the requirements with event handling facility. |

| **Learning Resources:** | |
|---|---|
| 1 | Java-The Complete Reference,Herbert Schildt, 9th Edition, McGraw Hill Education 2014 |
| 2 | HTML- Complete Reference,Powell, 3rd Edition, TMH 2007 |
| 3 | Core Java-An Integrated Approach, Dr. R.Nageswara Rao, Dreamtech 2015 |
| 4 | Programming with Java, E Balagurusamy , McGraw Hill Education, 2019 |

| **Course Name**: | **Cyber Security** | | |
|---|---|---|---|
| **Course Code**: | OE-CS701E | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Cyber law and intellectual Property right OE-EC501B |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To develop policies and procedures to manage enterprise security risk. |
| 2 | To comprehend different cyber governance and infrastructure issues |
| 3 | To provide technical leadership and service to their business, profession and society. |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **Introduction:**<br>Cyber Security , Cyber Security Policy , Domain of Cyber Security Policy , law and Regulations, Enterprise Policy , Technology Operations ,Technology configuration, Strategy Versus Policy , Cyber Security Evolution.<br>Productivity , Internet ,E commerce ,Counter Measures Challenges, Botnets. | 10 |
| 2 | **Cyber Security objectives and guidance:**<br>Cyber Security Metrics, Security Management Goals, Counting Vulnerabilities, Security Frameworks, E Commerce Systems, Industrial Control Systems, Personal Mobile devices, Security policy Objectives, Guidance for Decision Makers, Tone at the top, policy as a project, Cyber Security Management, Arriving at goals, Cyber Security Documentation, The Catalog Approach, Catalo Format , Cyber Security Policy Taxonomy. | 10 |
| 3 | **Cyber Governance Issues:**<br>Cyber Governance Issues, Net Neutrality, Internet Names and Numbers, Copyright and Trademarks, Email and Messaging. Cyber User Issues, Malvertising, Impersonation, Appropriate Use, Cyber Crime, Geo location, Privacy. Cyber Conflict Issues, Intellectual property Theft, Cyber Espionage Cyber Sabotage, Cyber Welfare. | 10 |
| 4 | **Cyber Infrastructure Issues:**<br>Cyber Infrastructure Issues, economics, finance and banking, Health care, Industrial Control systems. Cyber insurance, cyber security in international relations. | 6 |
| **Total** | | **36** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Explain cyber security policy and E-commerce. |
| 2 | Explain cyber security management goal. |
| 3 | Describe different cyber governance issues. |
| 4 | Describe cyber infrastructure issues. |

| **Learning Resources:** | |
|---|---|
| 1 | Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs, Jeffrey Schmidt, Joseph Weiss "Cyber Security Policy Guidebook" John Wiley & Sons 2012. |
| 2 | Rick Howard "Cyber Security Essentials" Auerbach Publications 2011. |
| 3 | B.G Raggad, " Information Security Management", CRC Press, Taylor Francis, 2015 |

| **Course Name**: | **Entrepreneurship** | | |
|---|---|---|---|
| **Course Code**: | OE-HU701A | **Category:** | Open Elective |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 3-0-0 | **Pre-Requisites:** | Basic understanding of Marketing and Finance |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To develop and strengthen entrepreneurial quality and motivation in students. |
| 2 | To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively |

| **Course Contents:** | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **ENTREPRENEURAL COMPETENCE & ENVIRONMENT**<br>Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations - International Business | 9 |

| | | |
|---|---|---|
| 2 | **BUSINESS PLAN PREPARATION**<br>Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria. Funding & Scaling Up, Ideation & Validation, Compliance & Business Plan Communication | 7 |
| 3 | **LAUNCHING OF SMALL BUSINESS**<br>Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection -Growth Strategies - Product Launching – Incubation, Angel Investor & Venture capital, IT startups. Validation Feasibility, ESOP, Field of Analytics based start up | 8 |
| 4 | **MANAGEMENT OF SMALL BUSINESS**<br>Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business.<br>Units- Effective Management of small Business. | 6 |
| **Total** | | **30** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Develop some knowledge and skills needed to run a business |
| 2 | Prepare proposal and business plan independently |
| 3 | Understand the central and state government policies and regulations |
| 4 | Understand basics of venture capital, incubations and IT Startups. |

| **Learning Resources:** | |
|---|---|
| 1 | Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001 |
| 2 | S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi. |

| **Course Name**: | **Principles of Management** | | |
|---|---|---|---|
| **Course Code**: | HM-HU702 | **Category:** | Management Science and Humanities |
| **Semester**: | Seventh | **Credit:** | 2 |
| **L-T-P**: | 2-0-0 | **Pre-Requisites:** | English |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 70 | Continuous Assessment: 25 | Attendance: 05 |

| **Course Objectives:** | |
|---|---|
| 1 | To understand basic concept and approaches to management. |
| 2 | To understand planning and decision-making processes. . |
| 3 | To understand organizational design and structure. |
| 4 | To understand various aspects of leadership. |

| **Course Contents:** | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| 1 | **Concept & approaches to management:** Meaning & Definition of the term Management, Management as a Science or an Art, Management as a Profession, Management as a Process, Difference between Management & Administration; Levels of Management, Roles of a Manager, Quality of a good Manager, Significance of Management, Limitations of Management, Business Environment and its interaction with Management. Approaches to Management – Classical, Neo-classical and Modern Contributors to Management Thought – Taylor and Scientific Theory, Fayol's and Administrative Theory, Peter Drucker and MBO. | 8 |
| 2 | **Planning & decision making:** Planning: Meaning, Definition, Process, Types, Principles, Premises Significance & Limitations of Planning; Strategic Planning – Meaning & Process, MBO – Meaning, Process and Requirements for Implementation. Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree of Decentralization, Difference between Delegation and Decentralization. | 8 |
| 3 | **Directing:** Motivation – Meaning, Definition, Significance & Limitations; Financial and non-financial incentives of Motivation Leadership - Meaning, Definition, Significance of Leadership, Leadership styles Type, Process and Barriers of Communication, Strategies to overcome barriers. | 4 |
| 4 | **Operations & Technology Management** – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma. | 4 |
| **Total** | | **24** |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Explain the concept and approaches of Management. |
| 2 | Demonstrate the roles, skills and functions of management. |
| 3 | Diagnose and solve organizational problems. |
| 4 | Apply different methods of Customer, Operation and Technology management. |

| **Learning Resources:** | |
|---|---|
| 1 | Essentials of Management. H. Koontz and H. Weihrich , 7th Edition, Tata McGraw Hill, India. |
| 2 | Principles of Management, Premvir Kapoor, Khanna Publishing House, 2019 |
| 3 | Principles of Management - Text and Cases, Dipak Kumar Bhattacharyya. Pearson Education, India 2011. |
| 4 | Principles of Management, T. Ramaswami, Himalaya Publishing House, 2014 |
| 5 | Industrial Engineering and Production Management, Mahajan, M., Dhanpat Rai & Co. |
| 6 | Principles of Management, Gupta, Gupta and Shair, Kalyani Publishers. |

| **Course Name**: | **Industrial Training** | | |
|---|---|---|---|
| **Course Code**: | PW -EC781 | **Category:** | Sessional |
| **Semester**: | Seventh | **Credit:** | 1 |
| **L-T-P**: | During Semester Break(6th& 7th) | **Pre-Requisites:** | |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 100 | Continuous Assessment: 00 | Attendance: 00 |

| **Course Objectives:** | |
|---|---|
| 1 | Participate in industry projects. |
| 2 | Get knowledge of advanced tools and techniques used in industries. |
| 3 | Communicate with industry personnel , know about industry practices and discipline. |
| 4 | To know the process of work report and presentation preparation. |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| | The object of Industrial Training is to familiar the students with different industry related project works and acquire knowledge about the broad field of Electronics & Communication Engineering in industry. Students may appear for the training assigned by the Department / personally arranged on an individual basis or two/three students in a group.<br>The guidelines for execution and evaluation includes:<br>1. Participate in the training during the $6^{th}$ & $7^{th}$ semester break.<br>2. After completion of the training prepare a written Report on the training topic.<br>3. Prepare a presentation on training and place it before a departmental committee. | |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Participate in the projects of industries during his or her industrial training. |
| 2 | Describe use of advanced tools and techniques encountered during industrial training and visit. |
| 3 | Interact with industrial personnel and follow engineering practices and discipline prescribed in industry. |
| 4 | Develop awareness about general workplace behavior and build interpersonal and team skills. |
| 5 | Prepare professional work reports and presentations. |

| **Learning Resources:** | |
|---|---|
| 1 | Relevant Manuals and literatures from various sources. |
| | |

| **Course Name**: | **Project-I** | | |
|---|---|---|---|
| **Course Code**: | PW-EC782 | **Category:** | Sessional |
| **Semester**: | Seventh | **Credit:** | 3 |
| **L-T-P**: | 0-0-6 | **Pre-Requisites:** | Knowledge on domain of project work and associated tools. |
| **Full Marks:** | 100 | | |
| **Examination Scheme:** | Semester Examination: 100 | Continuous Assessment: 00 | Attendance: 00 |

| Course Objectives: | |
|---|---|
| 1 | To impart concepts of literature survey . |
| 2 | To impart knowledge about handling a topic independently to develop an approach for solution. |
| 3 | To impart knowledge about preliminary Modelling/Simulation/Experiment/Design related to the topic |
| 4 | To impart knowledge about writing a project report and preparing presentation on the topic. |

| Course Contents: | | |
|---|---|---|
| **Module No.** | **Description of Topic** | **Contact Hrs.** |
| | The objective of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/four students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment should normally include:<br>1. Survey and study of published literature on the assigned topic<br>2. Working out a preliminary Approach to the Problem relating to the assigned topic<br>3. Conducting preliminary Modelling/Simulation/Experiment/Design.<br>4. Preparing a Written Report on the Study conducted for presentation to the Department<br>5. Final Seminar, as oral Presentation before a departmental committee. | 30 |
| | | |

| Course Outcomes: | |
|---|---|
| After completion of the course, students will be able to: | |
| 1 | Describe their project objective and state different research-oriented topics reviewed, related to their project work |
| 2 | Formulate mathematical expressions/ design electronic circuits relevant to their project objective. |
| 3 | Practically implement the designed circuits, apply different scientific software tools and techniques for design, simulation, analysis and interpretation. |
| 4 | Report and present their work and function in collaboration with the team members. |

| Learning Resources: | |
|---|---|
| 1 | Associated Books, Journals, Magazines and resources from Internet. |