

FACULTY OF ENGINEERING
Scheme of Instruction & Examination
(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Electronics and Communication Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)



Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(ELECTRONICS AND COMMUNICATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC 701 EC	Embedded System	3	-	-	3	30	70	3	3
2	PC 702 EC	VLSI Design	3	-	-	3	30	70	3	3
3	PC 703 EC	Microwave Techniques	3	-	-	3	30	70	3	3
4	HS 707 ME	Industrial Administration and Financial Management	3	-	-	3	30	70	3	3
5		Professional Elective – II	3	-	-	3	30	70	3	3
6		Open Elective – II	3	-	-	3	30	70	3	3
7		Open Elective – III	3	-	-	3	30	70	3	3
8	MC 771 EG	Human Values and Professional Ethics	2	-	-	2	30	70	3	-
Practical/ Laboratory Courses										
9	PC 751 EC	Microwave Lab	-	-	2	2	25	50	3	1
10	PC 752 EC	Electronic Design & Automation Lab	-	-	2	2	25	50	3	1
11	PW 761 EC	Project Work – I	-	-	4	4	50	-	-	2
12	SI 762 EC	Summer Internship	-	-	-	-	50	-	-	2
			23	-	08	31	390	660		27

Professional Elective – II			Open Elective – II		
S. No.	Course Code	Course Title	S. No.	Course Code	Course Title
1	PE 721 EC	Mobile and Cellular Communications	1	OE 771 CE	Green Building Technologies
2	PE 722 EC	Speech Signal Processing	2	OE 772 CS	Data Science Using R Programming
3	PE 723 EC	Electronic Measurements and Instrumentation	3	OE 773 EC**	Fundamentals of IoT
4	PE 724 EC	Digital Signal Processor Architectures	4	OE 774 EE	Non-Conventional Energy Sources
			5	OE 775 ME	Entrepreneurship
Open Elective – III			PC: Professional Course PE: Professional Elective L: Lectures T: Tutorials P: Practical D: Drawing CIE: Continuous Internal Evaluation SEE: Semester End Examination (Univ. Exam)		
S. No.	Course Code	Course Title			
1	OE 781 CE	Road Safety Engineering			
2	OE 782 IT	Software Engineering			
3	OE 783 EC**	Principles of Electronic Communications			
4	OE 784 EE	Illumination and Electric Traction systems			
5	OE 785 ME	Mechatronics			

Note: 1) Each contact hour is a Clock Hour

2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Note-2: * The students have to undergo a Summer Internship of four weeks' duration after VI semester and credits will be awarded in VII semester after evaluation.

** Subject is not offered to the students of ECE Department.

Course Code	Course Title				Core / Elective		
PC 701 EC	Embedded System				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
MPMC PC603EC COA PC505EC	3	-	-	-	30	70	3
Course Objectives							
<ul style="list-style-type: none"> ➤ Understand embedded systems, hardware and software components and design process of embedded system. ➤ List the RISC features of ARM core and study its architecture and instruction set. ➤ Acquire the knowledge about serial, parallel bus communication protocols and internet enabled systems-network protocols. ➤ Know about the steps, issues in the embedded system development process and different techniques for downloading embedded firmware into hardware. ➤ Familiarize with the different IDEs for firmware development for different family of processors/controllers and learn about different tools and techniques for embedded hardware debugging. 							
Course Outcomes							
After completing this course, the student will be able to							
<ol style="list-style-type: none"> 1. Understand the fundamentals of the embedded system design 2. Enumerate the instruction set of ARM Processor by studying the architecture of ARM core 3. Acquire knowledge on the serial, parallel and network communication protocols. 4. Learn the embedded system design life cycle and co-design issues. 5. List the various embedded software development tools used in the design of embedded system for various applications. 							

UNIT –I

Introduction to Embedded Systems: Classification, Embedded Processor in a system, Embedded Hardware and Software: Processor embedded into a system, Processor selection for Embedded System, Embedded System-On-Chip, Design process in Embedded System, Characteristics and quality attributes of embedded systems, Design metrics and challenges in Embedded System design.

UNIT-II

The Arm Processor Fundamentals and Instruction set: RISC concepts with ARM Processors, Registers, Current Program status register, pipeline, Exception, Exceptions, Conditional execution, Interrupts and vector table, Core extensions, Architectural Revisions, Arm processors Families.

Introduction to ARM Instruction Set: Data processing instructions, Branch instructions, Data transfer instructions, Software interrupt, and Program status register instructions.

UNIT-III

Serial Bus Communication protocols: I²C, CAN, USB, Fire wire-IEEE 1394 Bus standard, advanced serial high speed buses. Parallel Bus device protocols: ISA, PCI, PCI-X, ARM Bus, Advanced parallel high speed buses. Internet Enabled Systems-Network protocols: HTTP, TCP/IP, Ethernet.

UNIT-IV

Embedded Software Development Process and Tools: Embedded System design and co-design issues in system development process, Design cycle in the development phase for an Embedded Systems. Embedded software development tools: Host and Target Machines, Linker/Locators for embedded software, Embedded Software into the Target system.

UNIT-V

Testing Simulation and Debugging Techniques and Tools: Integration and testing of embedded hardware, testing methods, debugging techniques, Laboratory tools and target hardware debugging: Logic Analyser, simulator, emulator and in circuit emulator, IDE, RTOS Characteristics, Case Study: Embedded Systems design for automatic vending machines and digital camera.

Suggested Readings:

1. Raj Kamal, *“Embedded Systems-Architecture, Programming and Design,”* 2/e, TMH, 2012.
2. Shibu K V, *“Introduction to Embedded systems”*, 1/e, McGraw Hill Education, 2009.
3. David E. Simon, *“An Embedded software primer,”* Pearson Education, 2004.
4. Steve Furber, *“ARM System on chip Architecture,”* 2/e, Pearson Education.
5. Andrew N. Sloss, Dominic Symes, Chris Wright, *“ARM SYSTEM Developer’s Guide Designing and Optimizing System Software”* Elsevier 2015

Course Code	Course Title					Core / Elective	
PC 702 EC	VLSI Design					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ED PC302EC STLD PC303EC DSD PC506EC	3	1	-	-	30	70	3

Course Objectives

- Explain electrical properties of MOS and BiCMOS devices to analyse the behavior of inverters designed with various loads.
- Give exposure to the design rules to be followed to draw the layout of any logic circuit.
- Provide concept to design different types of Combinational and arithmetic circuits.
- Learn to design sequential logic circuits using CMOS transistor.
- Study the small signal model various amplifiers.

Course Outcomes

By the end of this course, the students will be able to

1. Analyse modes of operation of MOS transistor and its basic electrical properties
2. Draw stick diagrams and layouts for any MOS transistors and calculate the parasitic R&C
3. Analyse the operation of various arithmetic circuits.
4. Design sequential logic circuits using CMOS transistors
5. Understand the small signal model and characteristics of CMOS amplifiers

UNIT - I

Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies- Fabrication Process.

Basic Electrical Properties: Basic Electrical Properties of MOS and Bi-CMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT - II

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Gate Level Design: Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations – RC Delays.

UNIT - III

Subsystem Design: Shifters, Adders: Carry skip, carry select, square root carry select, Manchester; ALU, Multipliers: Booth, Baugh-Woolley, High Density Memory Elements: SRAM, DRAM, ROM Design.

UNIT - IV

Sequential Logic Design: Behavior of Bi-stable elements, SR Latch, Clocked Latch and Flip-flop circuits, CMOS D latch and Edge triggered Flip flops.

CMOS Testing: CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

UNIT - V

Analog VLSI Design: Small signal model of MOSFETs, Simple CMOS current mirror, Common Source Amplifier, Source follower, Common Gate Amplifier, Source degenerated current mirror, Casode and Wilson current mirrors.

Suggested Readings:

1. Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, “Essentials of VLSI circuits and systems”, PHI, 2005 Edition.
2. Weste and Eshraghian, “Principles of CMOS VLSI Design”, Pearson Education, 1999.
3. John.P. Uyemura, “Introduction to VLSI Circuits and Systems”, JohnWiley, 2003.
4. John M. Rabaey, “Digital Integrated Circuits”, PHI, EEE, 1997.
5. Wayne Wolf,” Modern VLSI Design”, Pearson Education, 3rd Edition, 1997.

Course Code	Course Title					Core / Elective	
PC 703 EC	Microwave Techniques					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AWP PC602EC EMTL PC404EC	3	1	-	-	30	70	3
Course Objectives							
<ul style="list-style-type: none"> ➤ Understand the concept of Guided waves and its propagation in different modes (TE, TM, and TEM) between parallel planes and to find out applications of different parameters. ➤ Use of the concept of TE, TM & TEM waves in Waveguides (Rectangular and Circular) and evaluate different parameters & understand the operation of Cavity Resonators. ➤ Understand the concept of Microwave circuit and evaluate Scattering parameters of microwave components. ➤ Understand the high frequency limitations of conventional tubes and principle of bunching and velocity modulation analyse the operation of microwave tubes ➤ Understand principle and operation of Microwave solid state devices & evaluate the characteristics of devices & concept of strip lines, slot lines and fin lines. 							
Course Outcomes							
After completing this course, the student will be able to							
<ol style="list-style-type: none"> 1. Analyse the propagation of Guided waves in different modes between parallel planes. 2. Evaluate different parameters (Like impedance, attenuation and quality factor.) for Rectangular & Circular Waveguides & Cavity Resonators. 3. Determine Scattering parameters of different microwave components and analyse their properties. 4. Integrate the concept of bunching and velocity modulation to summarize the operation of microwave tubes and the high frequency limitations of conventional tubes. 5. Analyse the principle, operation and characteristics of different microwave solid state devices 							

UNIT-I

Guided Waves: Propagation of TE, TM and TEM waves between parallel planes. Velocity of propagation, wave impedance, attenuation in parallel plane guides.

UNIT-II

Waveguides: TE and TM waves in rectangular and circular waveguides, Wave Impedance, Characteristic Wave Impedance, Attenuation and Q of waveguides. Cavity resonators, resonant frequency and Q, Applications of cavity resonator.

UNIT-III

Microwave Circuits and Components: Concept of Microwave circuit, Normalized voltage and current, Introduction to scattering parameters and their properties, S parameters for reciprocal and Non-reciprocal components- Magic Tee, Directional coupler, E and H Plane Tees and their properties, Attenuators, Phase Shifters, Isolators and circulators.

UNIT-IV

Microwave Tubes: High frequency limitations of conventional tubes, Bunching and velocity modulation, mathematical theory of bunching, principles and operation of two cavity, multi cavity and Reflex Klystron.

Theory of crossed field interaction: Principles and operation of magnetrons and crossed field amplifiers, TWT and BWO.

UNIT-V

Microwave Solid State Devices: Principles of operation, characteristics and applications of Varactor, PIN diode, GUNN diode and IMPATT diode.

Elements of strip lines, micro strip lines, slot lines and fin-lines.

Suggested Readings:

1. E. C. Jordan & Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", 2/e, Pearson Education, 2006.
2. Samuel Y. Liao, "Microwave Devices and Circuits", 3/e, Pearson Education, 2003.
3. R. E. Collins, "Foundations for Microwave Engineering", 2/e, Wiley India Pvt. Ltd., 2012.
4. Annapurna Das and Sisir K., "Microwave Engineering", McGraw Hill Education, Third edition, 2014.
5. Skalnik, Krauss, Reich, "Microwave principles", East West Press, 1976.

Course Code	Course Title				Core / Elective		
HS 707 ME	Industrial Administration and Financial Management				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
MEA HS901MB	3	-	-	-	30	70	3
Course Objectives							
<ul style="list-style-type: none"> ➤ To understand various types of organizational structures, manufacturing processes and 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							
After completing this course, the student will be able to							
<ol style="list-style-type: none"> 1. Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems and role of scheduling function in better utilization of resources 2. Understand the Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP –II. 3. Know the different terminology used in financial management and understand the different techniques of capital budgeting and various types of costs involved in running an industrial organization. 							

UNIT – I

Industrial Organization: Types of various business organisations, Organisation structures and their relative merits and demerits. Functions of management.

Plant Location and Layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits.

UNIT – II

Work Study: Definitions, objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time by time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans.

UNIT – III

Inspection and Quality Control: Types and objectives of inspection S.Q.C., its principles. Quality control by chart and sampling plans. Quality circles, introduction to ISO.

UNIT – IV

Optimization: Introduction to linear programming and its graphical solutions. Assignment problems.

Project Management: Introduction to CPM and PERT. Determination of critical path.

Material Management: Classification of materials, Materials planning.

Duties of purchase manager. Determination of economic ordering quantities. Types of materials purchase.

UNIT – V

Cost Accounting: Elements of cost. Various costs. Types of overheads. Breakeven analysis and its applications. Depreciation. Methods of calculating depreciation fund. Nature of financial management. Time value of money. Techniques of capital budgeting and methods. Cost of Capital, Financial leverage.

Suggested Readings:

1. Pandey I.M., “Elements of Financial Management”, Vikas Publications House, New Delhi, 1994.
2. Khanna O.P., “Industrial Engineering and Management”, Dhanpat Rai & Sons.
3. Marshall/Bansal, “Financial Engineering”, PHI.
4. Keown, “Financial Management”, 9/e, PHI.
5. Chandra Bose, “Principles of Management & Administration”, PHI.

Course Code	Course Title				Core / Elective		
PE 721 EC	Mobile and Cellular Communications				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To understand the concept and implementation of frequency reuse and Handoff techniques and to analyse interference and capacity enhancement.
- To appreciate the factors influencing outdoor and indoor propagation systems
- To analyse various multiple access protocols based on their merits and demerits.
- To visualize the system architectures and implementation of GSM and CDMA based mobile communication systems.
- To understand the concepts in various Mobile Technologies

Course Outcomes

After completing this course, the student will be able to

1. Understand the method of selection and reuse of a set of frequency channels, Base station requirement, signals required for communication and hand over between Base stations
2. Appreciate and understand the methods of electromagnetic wave propagation in cellular communication. The evaluation of the electromagnetic energy reaching the mobile unit.
3. Identify different a methods of mobile access technologies and which of them suitable for mobile cellular solutions. Understand process used for Bluetooth, ZigBee like low power devices
4. Explain features, authentication, operational details of GSM and CDMA mobile cellular systems along with data frame structure details.
5. The development and limitation of the preliminary and advanced generation of mobile systems. Present trends in Cellular communications and the future communication requirements.

UNIT-I

Basic Cellular system and its operation, frequency reuse, channel assignment strategies, Handoff process, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Cross talk, Enhancing capacity and cell coverage, Trunked radio system. Manual and Automatic Electronic Exchanges.

UNIT-II

Free space propagation model, three basic propagation mechanisms, practical link budget design using path loss models, outdoor propagation models: Durkin's model and indoor propagation model, partition losses. Small scale multipath propagation, Parameters of mobile multipath channels, types of small scale fading. Cell Tower Antenna/radiation pattern, Mobile antennas/ radiation patterns

UNIT-III

Data multiple access Technologies in Communication: FDMA, TDMA, SSMA, FHMA, CDMA, SDMA, Packet radio protocols, CSMA, Reservation protocols time Frame details.

UNIT-IV

GSM: Services and Features, System architecture, Radio Sub system, Channel Types, Frame structure and Signal processing.

CDMA: Digital Cellular standard IS-95, Forward Channel, Reverse Channel.

UNIT-V

Comparison of Mobile communication Technologies: 1G, 2G and 2.5G, technology Features of 3G and 4G and 5G, WLAN, Bluetooth, PAN, Trends in Radio and Personal Communications, UMTS system architecture and Radio Interface.

Suggested Readings:

1. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice,” 2/e, Pearson Education, 2010.
2. William. C.Y. Lee, “Mobile Communication Engineering,” 2/e, Mc-Graw Hill, 2008.
3. T.L. Singal “Wireless Communication Systems,” 1/e, TMH Publications, 2010.
4. William.C.Y. Lee, “Mobile Cellular Telecommunications: Analog and Digital Systems,” 2/e, Mc-Graw Hill, 2011.

Course Code	Course Title				Core / Elective		
PE 722 EC	Speech Signal Processing				Elective		
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DIP PE671EC	3	-	-	-	30	70	3

Course Objectives

- Understand the basic mechanism of human speech production.
- Understand digital representation of speech waveforms.
- Understand Short-time analysis and Synthesis techniques.
- Understand Speech Synthesizers.
- Understand the various problems with Automatic speech recognition.

Course Outcomes

After completing this course, the student will be able to

1. Grasp the basic mechanism of human speech production.
2. Understand digital representation of speech waveforms.
3. Do Short-time analysis and Synthesis techniques.
4. Analyse Speech Synthesizers.
5. Understand the various problems with Automatic speech recognition

UNIT I

Introduction to Speech Processing: The mechanism of Speech production, Acoustic Phonetics, Source-Filter model of speech production.

Representation of Speech waveforms: Delta modulation, Adaptive delta modulation, Differential PCM, Adaptive differential PCM.

UNIT II

Time-domain models for Speech processing: Short -Time Energy function, Zero crossing rate, End point detection, Pitch Period Estimation, Vector quantization. Format Tracking

UNIT III

Speech Signal Analysis: Short-Time Fourier analysis, Auto correlation function, Linear Predictive Analysis, Pitch Synchronous Analysis.

Homomorphic Speech Processing: The Complex Cepstrum of Speech and its properties, Applications of Cepstral Processing

UNIT IV

Speech Synthesis: Format Synthesis, Linear Predictive Synthesis, Introduction to Text-to-speech, Articulatory speech synthesis.

Speech Coders: Sub-band coding, Transforms coding, Channel decoder, Formant decoder, Linear Predictive decoder, Vector Quantizer coder.

UNIT V

Automatic Speech Recognition: Problems in Automatic Speech Recognition, Dynamic warping, Hidden Markov models, Speaker Identification / verification.

Suggested Readings:

1. L R Rabiner & R W Schafer, "Digital Processing of Speech Signals", PHI, 1978.
2. F J Owens, "Signal Processing of Speech", Macmillan, 2000.
3. Papamchalis, "Practical Approaches to Speech Coding", PHI, 1987.

4. Daniel Jurefskey & James H. Martin, "*Speech and Language Processing*", Pearson Education, 2003.
5. Thomas W. Parsons, "*Voice and Speech Processing*", Mc GRAWHILL, 1986.

Course Code	Course Title				Core / Elective		
PE 723 EC	Electronic Measurements and Instrumentation				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ED PC302EC LICA PC501EC	3	-	-	-	30	70	3

Course Objectives

- Understand the different standards of measurements.
- Study different types of transducers.
- List various types of measurements and thermometers.
- Learn the design of digital voltmeters
- Study various types of bio-medical instruments.

Course Outcomes

After completing this course, the student will be able to

1. Describe characteristic of an instrument and state different Standards of measurements
2. Identify and explain different types of Transducers.
3. Draw and Interpret types of transducers.
4. Design and analyse the digital voltmeters and Prioritize the instruments.
5. Identify and classify types of Biomedical instruments.

UNIT-I

Accuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards.

UNIT-II

Transducers: classification, factors for selection of a transducer, transducers for measurement of velocity, acceleration. Passive electrical transducers- Strain gauges and strain measurement, LVDT and displacement measurement, capacitive transducer and thickness measurement. Active electrical transducers: Piezo electric, photo conductive, photo voltaic and photo emissive transducers.

UNIT-III

Characteristics of sound, pressure, power and loudness measurement. Microphones and their types. Temperature measurement, resistance wire thermometers, semiconductor thermometers and thermocouples.

UNIT-IV

Block diagram, specification and design considerations of different types of DVMS. Spectrum analysers. The IEEE488 or GPIB Interface and protocol. Delayed time base oscilloscope and Digital storage oscilloscope. Introduction to virtual instrumentation, SCADA. Data acquisition system block diagram.

UNIT-V

Biomedical Instrumentation: Human physiological systems and related concepts. Bio-potential electrodes Bio-potential recorders – ECG, EEG, EMG, X- ray machines and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems.

Suggested Readings:

1. Albert D. Helfric, and William D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, PHI, 2010.
2. H S Kalsi, “Electronic Instrumentation”, 3/e, TMH, 2011.
3. Robert A Witte, “Electronic Test Instruments: Analog and Digital Measurements”, 2/e, 2002.

4. Nakra B.C, and Chaudhry K.K., “Instrumentation, Measurement and Analysis”, TMH, 2004.
5. Khandpur. R.S., “Handbook of Bio-Medical Instrumentation”, TMH, 2003.

Course Code	Course Title				Core / Elective		
PE 724 EC	Digital Signal Processor Architectures				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DSP PC 503 EC	3	-	-	-	30	70	3

Course Objectives

To make the student familiar with the concepts of

- To study the importance of DSPs and the numeric formats
- To analyse the implementation considerations.
- To elaborate on architectures of PDSPs.
- To compare architectures of different types of DSPs.
- To understand the concepts of Memory and peripheral & device I/O interfacing.

Course Outcomes

After completing this course, the student will be able to

1. Comprehend the importance of DSPs.
2. Highlight their implementation considerations.
3. Explain the architectures for PDSPs.
4. Compare various architectures of DSPs.
5. Integrate DSP programmable devices with external peripherals and devices.

UNIT-I

Major features of DSP Processors: Differences between DSP and other general purpose processor architectures, their comparison and need for special ASPs, RISC and CISC CPUs.

Data representations and arithmetic, finite word length effects.

UNIT-II

Implementation considerations: Real time implementation considerations. Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branch effects, Interrupt effects, Pipeline Programming models, sources of errors. DSP Tools – Assembler, debugger, c-compiler, linker, editor, Code Composer Studio.

Applications: Adaptive filtering, Spectrum analysis, Echo Cancellation modems, Voice synthesis and recognition.

UNIT-III

Architectures for Programmable DSP devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues.

UNIT-IV

Programmable Digital Signal Processors: Fixed point DSPs – Architecture of TMS 320C5X, C54X Processors, Addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSPs - Architecture of TMS320-1X-Data formats, Floating Point operations, Addressing Modes, instructions, pipelining and peripherals.

Overview of AD and Motorola DSP CPUs; Their comparison with TI CPUs.

UNIT-V

Memory and I/O Interfacing (C54X): Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct Memory Access

(DMA). Synchronous Serial Interface: A Multichannel buffered serial port (McBSP), a CODEC interface circuit. I/O interfacing with A/D converters.

Suggested Readings:

1. B. Venkataramani, M. Bhaskar, "Digital Signal Processors – Architecture, programming and Applications, Tata McGrawHill, 2nd ed., 2011.
2. Lapsley et al., "DSP Processor Fundamentals, Architectures & Features", S. Chand & Co, 2000.
3. Avtar Singh, S. Srinivasan, "Digital Signal Processing - Implementation using DSP Microprocessors with Examples from TMS32C54XX", Cengage Learning, 2004.
4. K. Shin, "DSP Applications with TMS 320 Family", Prentice Hall, 1987.
5. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing-Principles, Algorithms, and Applications", Prentice Hall of India, 2007.

Course Code	Course Title				Core / Elective		
OE 771 CE	Green Building Technologies				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To impart knowledge of the principles behind the green building technologies.
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings.
- To bring awareness of the basic criteria in the green building rating systems.
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. *Alternative building materials and technologies* by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. *Non-Conventional Energy Resources* by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual*, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, *Green Building Fundamentals*, Pearson, USA, 2010.
7. Charles J. Kibert, *Sustainable Construction - Green Building Design and Delivery*, John Wiley & Sons, New York, 2008.
8. Regina Leffers, *Sustainable Construction and Design*, Pearson / Prentice Hall, USA, 2009.

Course Code	Course Title				Core / Elective		
OE 772 CS	Data Science Using R Programming				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives							
<ul style="list-style-type: none"> ➤ 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							
At the end of the course, the students will be able to							
<ol style="list-style-type: none"> 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

Data Science: Introduction to data science, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

UNIT II

Statistical Modelling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

UNIT III

Predictive Modelling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression

UNIT IV

Introduction to R Programming, getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

UNIT V

Classification: performance measures, Logistic regression implementation in R, K-Nearest neighbours (KNN), K-Nearest neighbours implementation in R, Clustering: K-Means Algorithm, K-Means implementation in R.

Suggested Readings:

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly, 2017.
4. Roger D Peng, R Programming for Data science, Lean Publishing, 2016.
5. Rafael A Irizarry, Introduction to Data Science, Lean Publishing, 2016.

Course Code	Course Title				Core / Elective		
OE 773 EC	Fundamentals of IoT				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	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

At the end of the course, the students will be able to

1. Understand the various applications of IoT and other enabling technologies. Comprehend various protocols and communication technologies used in IoT
2. Design simple IoT systems with requisite hardware and C programming software Understand the relevance of cloud computing and data analytics to IoT
3. 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, IAAS. Communication APIs, Amazon web services 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 Start-up, 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.
2. *Designing the Internet of Things*, Adrian McEwen (Author), Hakim Cassimally. Wiley India Publishers.
3. *Fundamentals of embedded software: where C meets assembly* by Daneil W lewies, Pearson.
4. *Internet of things -A hands on Approach*, Arshdeep Bahga, Universities press.

Course Code	Course Title				Core / Elective		
OE 774 EE	Non-Conventional Energy Sources				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

Course Outcomes

On completion of course the student will be able to:

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Understand the Solar energy power development and different applications.
3. Understand different wind energy power generation techniques and applications.
4. Design a prescribed engineering sub-system
5. Recognize the need and ability to engage in lifelong learning for further developments in this field.

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 H₂ O₂ 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 gasifiers.

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.

Course Code	Course Title				Core / Elective		
OE 775 ME	Entrepreneurship				Open Elective-II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise & project management
- To understand the design principles of solar energy systems, their utilization and performance evaluation
- To understand the behavioural aspects of entrepreneurs and time management

Course Outcomes

At the end of the course, the students will be able to

1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

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. Stephen R. Covey and A. Roger Merrill, *“First Things First”*, Simon and Schuster Publication, 1994.
4. G.S. Sudha, *“Organizational Behaviour”*, 1996.
5. Robert D. Hisrich, Michael P. Peters, *“Entrepreneurship”*, Tata Me Graw Hill Publishing Company Ltd., 5th Ed., 2005.

Course Code	Course Title				Core / Elective		
OE 781 CE	Road Safety Engineering				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	0	0	30	70	3
Course Objectives							
<ul style="list-style-type: none"> ➤ Introduction to various factors considered for road safety and management ➤ Explain the road safety appurtenances and design elements ➤ Discuss the various traffic management techniques 							
Course Outcomes							
At the end of the course, the students will be able to							
<ol style="list-style-type: none"> 1. Prepare accident investigation reports and database 2. Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools 3. Manage traffic including incident management 							

UNIT – I

Road Accidents: Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics, Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

UNIT – II

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & Driver characteristics influencing road safety.

UNIT – III

Road Signs and Traffic Signals: Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, pedestrians' safety, fixed and vehicle actuated signals. Design of signals, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

UNIT – IV

Traffic Management Techniques: Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, One-way streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

UNIT – V

Incident Management: Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management

programs. National importance of survival of Transportation systems during and after all natural disasters especially cyclones, earthquakes, floods etc. and manmade disasters like sabotage, terrorism etc.

Suggested Readings:

1. Guidelines on Design and Installation of Road Traffic Signals, IRC:93.
2. Specification for Road Traffic Signals, IS: 7537-1974.
3. Principles and Practice of Highway Engineering by L.R. Kadiyali and N.B. Lal.
4. Hand Book of T.E. Myer Kutz, Editor McGraw Hill, 2004.

Course Code	Course Title				Core / Elective		
OE 782 CS	Software Engineering				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	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 importance of software modelling using UML
- To understand the importance of testing in software development and study various testing strategies and software quality metrics.

Course Outcomes

At the end of the course students will be able to:

1. Acquire knowledge about different software development processes and their usability in different problem domains.
2. Understand the process of requirements collection, analysing, and modelling requirements for effective understanding and communication with stakeholders.
3. Design and develop the architecture of real world problems towards developing a blueprint for implementation.
4. Use the UML language to design various models during software development life cycle.
5. Understand the concepts of software quality, testing and maintenance.

UNIT-I

The software Problem: Cost, Schedule and Quality, Scale and change, Software Processes: - Process and project, Component Software Processes, Software Development Process Models, Project management Process.

UNIT-II

Software Requirements Analysis and Specification: Value of a good SRS, Requirements Process, Requirements Specification, Functional Specification with Use Cases, Other approaches for analysis. Software Architecture: Role of Software Architecture Views, Component and connector view, Architectural styles for C & C view, Documenting Architecture Design, Evaluating Architectures.

UNIT-III

Planning a Software Project: Effort Estimation, Project Schedule and staffing, Quality Planning, Risk Management Planning, Project Monitoring Plan, Detailed Scheduling. Design: Design concepts, Function oriented Design, Object Oriented Design, Detailed Design, Verification, Metrics.

UNIT-IV

Coding and Unit Testing: Programming Principles and Guidelines, incrementally developing code, managing evolving code, unit testing, code inspection, Metrics. Testing: Testing Concepts, Testing Process, Black Box testing, White box testing, Metrics.

UNIT-V

Maintenance and Re-engineering: Software Maintenance, supportability, Reengineering, Business process Reengineering, Software reengineering, Reverse engineering; Restructuring, Forward engineering, Economics of Reengineering. Software Process Improvement: Introduction, SPI process, CMMI, PCMM, Other SPI Frameworks, SPI return on investment, SPI Trends.

Suggested Readings:

1. Pankaj Jalote, "Software Engineering- A Precise Approach", Wiley India, 2010.
2. Roger. S. Pressman, "Software Engineering - A Practitioner's Approach", 7th Edition, McGraw Hill Higher Education, 2010.
3. Deepak Jain, "Software Engineering", Oxford University Press, 2008.
4. Rajib Mall, "Fundamentals of Software Engineering", 4th Edition, PHI Learning, 2014.
5. Ian Sommerville, "Software Engineering", 10th Edition, Addison Wesley, 2015.

Course Code	Course Title				Core / Elective		
OE 783 EC	Principles of Electronic Communications				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives							
<ul style="list-style-type: none"> ➤ Provide an introduction to fundamental concepts in the understanding of communications systems. ➤ Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer. ➤ Provide an introduction to the evolution of wireless systems and current wireless technologies. 							
Course Outcomes							
<ol style="list-style-type: none"> 1. Understand the working of analog and digital communication systems 2. Understand the OSI network model and the working of data transmission 3. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems. 							

UNIT – I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.

Signal Transmission Concepts: Baseband transmission and Broadband transmission,

Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for modulation

Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT – II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT – III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT – IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.

Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT – V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. *Principles of Electronic Communication Systems*, Louis E. Frenzel, 3e, McGraw Hill, 2008.
2. *Data Communications and Networking*, Behrouz A. Forouzan, 5e TMH, 2012.
3. Kennedy, Davis, *Electronic Communications systems*, 4e, McGraw Hill, 1999.

Course Code	Course Title				Core / Elective		
OE 784 EE	Illumination and Electric Traction Systems				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electrification of traction system

Course Outcomes

On successful completion of course, students will be able to:

1. Design the resistive and inductive heating and calculate the requirements of heating power for an industrial need
2. Analyse the type of motor control required and select the type and rating of motor.
3. Understand and Design illumination for different application
4. Understand the traction and use of DC machines
5. Analyse the traction mechanics to arrive at a rating of drive.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens — Design of elements. Core type, Coreless type furnaces, High frequency eddy current heating, Dielectric heating. Arc furnace. Electric welding, Resistance welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

UNIT-II

Schematic Utilization and Connection Diagrams for Motor Control: Two supply sources for 3 phase Induction motors. Direct reversing, remote control operation, and jogging operating of Induction motor. Contactor control circuit. Push button control stations. Over load relays, limit switches, float switches. Interlocking methods for reversing control.

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.

Traction Motors: Desirable characteristics, DC series motors, AC series motors 3-phase induction motors, DC motor series & parallel control, Energy saving.

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.

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

Suggested Readings:

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 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.

Course Code	Course Title				Core / Elective		
OE 785 ME	Mechatronics				Open Elective-III		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

Student has to understand the

- How to identify, formulate, and solve engineering problems
- The design a system, component, or process to meet desired needs within realistic constraints
- The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
- The use of drive mechanisms and fluid power systems
- The use of industrial electronic devices
- The demonstrate the design of modern CNC machines, and Mechatronics elements

Course Outcomes

At the end of the course, the students will be able to

1. Model and analyse electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems
3. Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various Mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and Mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems
Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro pneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to microprocessor & micro controller, Temperature measurement interface and LVDT interface, Systems response

UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Readings:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histan & David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

Course Code	Course Title				Core / Elective		
MC 771 EG	Human Values and Professional Ethics				Mandatory		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-

Course Objectives

Student has to understand the

- To develop a critical ability to distinguish between essence and form, or between what is of value and what is superficial, to life.
- To move from discrimination to commitment. It is to create an ability to act on any discrimination in a given situation.
- It encourages students to discover what they consider valuable. After learning the course, they should be able to discriminate between valuable and the superficial in real situations in their life.

Course Outcomes

At the end of the course, the students will be able to

1. It ensures students sustained happiness through identifying the essentials of human values and skills.
2. It facilitates a correct understanding between profession and happiness
3. It helps students understand practically the importance of trust, mutually satisfying human behavior and enriching interaction with nature.
4. Ability to develop appropriate technologies and management patterns to create harmony in professional and personal life.

UNIT - I

Course Introduction - Need, basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education. Self-Exploration - what is it? - its content and process; 'Natural Acceptance' and Experiential Validation - as the mechanism for self-exploration. Continuous Happiness and Prosperity - A look at basic Human Aspirations. Right understanding, Relationship and Physical Facilities - the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT - II

Understanding Harmony in the Human Being - Harmony in Myself!: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

UNIT - III

Understanding Harmony in the Family and Society - Harmony in Human - Human Relationship: Understanding harmony in the Family the basic unit of human interaction. Understanding values in human - human relationship; meaning of justice and program for its fulfillment; Trust and Respect as the foundational values of relationship. Difference between intention and competence. Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family)

UNIT - IV

Understanding Harmony in the nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

UNIT - V

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Suggested Readings:

1. R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Prof. K. V. Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications, 3rd Edition. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
3. E. F. Schumaner, 1973, Small is Beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.
4. A Nagraj, 1998 Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak. Susan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986
5. Smriti Shrivastava, "Human Values and Professional Ethics", Katson Publications, 2007

Course Code	Course Title					Core / Elective	
PC 751 EC	Microwave Lab					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

- Understand the characteristics of RKO and Gunn oscillator.
- Measurement of frequency and wavelengths would be learnt by the student.
- VSWR various TEES would be understood by the student.
- Radiation pattern would be learnt by the student for horn antenna.
- How to Create, Simulate and analyse the different types of Microstrip Antennas by using EM simulation software.

Course Outcomes

After completing this course, the student will be able to

1. Analyse frequency, Wave length, SWR and Impedance for Reflex Klystron Oscillator by using its equation.
2. Evaluate of mode characteristics of Reflex klystron and V-I Characteristics of Gunn diode.
3. Analyse of the characteristics of Circulator, Isolator, Directional Coupler, Tees like (Magic tee, E & H plane tees) using the Scattering parameters.
4. Generate the Radiation pattern of different antennas like Yagi-Uda and Horn Antenna and measure the gain of the antennas.
5. Familiarize with the EM simulation software

List of experiments

1. Characteristics of Reflex Klystron oscillator, finding the mode numbers and efficiencies of different modes.
2. Characteristics of Gunn diode oscillator, Power Output Vs Frequency, Power Output Vs Bias Voltage.
3. Measurement of frequency and Guide wavelength calculation:
 - a. Verification of the relation between Guide wavelength, free space wavelength and cut-off Wavelength of X- band rectangular waveguide.
 - b. Verification of the straight line relation between $(1/\lambda_g)^2$ and $(1/\lambda_0)^2$ and finding the dimension of the guide.
4. Measurement of low and high VSWRs: VSWR of different components like matched terminals, capacitive and inductive windows, slide screw tuner for different heights of the tuning posts etc.
5. Measurement of impedance for horn antenna, Matched load and slide screw tuner.
6. To find the S-parameters of Directional coupler.
7. To find the S-parameters of Tees: E plane, H plane and Magic Tee.
8. To find the S-parameters of Circulator.
9. Measurement of radiation patterns for basic microwave antennas like horn and parabolic reflectors in E-plane and H-plane. Also to finding the gain, bandwidth and beamwidth these antennas.
10. How to Create, Simulate and Analyse the Dipole Antenna Structure by using EM simulation software
11. How to Create, Simulate and Analyse a Microstrip Rectangular Patch Antenna by using EM simulation software
12. How to Create, Simulate and Analyse a Probe Feed Patch Antenna by using EM simulation software
13. How to Create, Simulate and Analyse a The Triangular Microstrip Antenna by using EM simulation software

Note: At least 10 experiments to be carried out during the semester

Suggested Readings:

1. M L Sisodia & G S Raghuvanshi, "Basic Microwave Techniques and Laboratory Manual", New Age International (P) Limited, Publishers.
2. Ramesh Garg, Prakash Bhartia, Inder Bahl and Apisak Ittipiboon "Microstrip Antenna Design HandBook" Artech House Publishers, 2001

Course Code	Course Title				Core / Elective		
PC 752 EC	Electronic Design and Automation Lab				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1
Course Objectives <ul style="list-style-type: none"> ➤ Familiarize with the usage of IDE tools and execution of programs using ARM processor. ➤ Know about the usage of various devices like LCD, Temperature sensor, Buzzer, Stepper Motor by interfacing them to LPC2148. ➤ Understand the designing and implementation of combinational and sequential logic circuits using Verilog HDL. ➤ Study of Mentor Graphics Tools ➤ Implement basic gates at transistor level Course Outcomes After completing this course, the student will be able to <ol style="list-style-type: none"> 1. Familiarize with the usage of IDE tools and program using various on chip like LCD, Temperature sensor, Buzzer, Stepper Motor by interfacing them to ARM Processor 2. Design the digital logic circuits in various modelling styles using Verilog HDL 3. Familiarize with VLSI CAD tools like Mentor Graphics / Cadence 4. Implement basic gates at transistor level 5. Implement the digital circuits at transistor level. 							

PART-A

Interfacing Programs using embedded C on ARM Micro Controller Kit

1. Program to interface 8-Bit LED and switch interface
2. Program to implement Buzzer interface on IDE environment
3. Program to display message in a 2 line x 16 characters LCD display and verify the result in debug terminal
4. Stepper motor interface
5. ADC & Temperature sensor LM35 interface
6. Transmission from kit and reception from PC using serial port.

PART-B

Implementation of programs using Verilog HDL code on FPGA Board

1. Adders / Subtractors
2. Multiplexer / Demultiplexer
3. Flip flops
4. Counters/Registers
5. Vending Machine controller
6. Multipliers

PART C

Transistor Level implementation of CMOS circuits using VLSI CAD tool

1. Basic Logic Gates: Inverter, NAND and NOR
2. Half Adder and Full Adder
3. 4:1 Multiplexer
4. 2:4 Decoder

Note: A minimum of 10 experiments to be performed and at least 3 experiments from each part to be performed.

Course Code	Course Title				Core / Elective		
PW 761 EC	Project Work - I				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	50	-	2
Course Objectives							
<ul style="list-style-type: none"> ➤ 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							
<ol style="list-style-type: none"> 1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the 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 it in 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 be invited 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 their own 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 the last 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 award of 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:

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

Course Code	Course Title				Core / Elective		
SI 762 EC	Summer Internship				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	-	50	-	2

Course Objectives

- Produce an accurate record of work performed during the Internship/Co-op
- Apply engineering knowledge to a problem in industry
- Produce a technical report
- Discuss work in a team environment, if relevant to the project
- Conduct herself/himself responsibly, safely, and ethically in a professional environment

Course Outcomes

After completing this course, the student will be able to

1. Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of sessionals are to be based on the performance of the students at the workplace and awarded 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 Industry Attachment Program.

Note: Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.