ET401 DIGITAL SYSTEM DESIGN AND VERY LARGE SCALE INTEGRATION (VLSI)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION

This course is to teach students the way digital circuits are designed in practice today. The emphasis is on modern design methodology using Computer Aided Design (CAD) to meet desired specifications. This course is extension to digital logic design.This course introduces the role of Hardware Description Language (HDL), Verilog Hardware Description Language (VHDL) and Verilog in conceptual structures, descriptions and processing in VLSI system design.

DESIRABLE AWARENESS/SKILLS

A background of digital logic design

COURSE OBJECTIVES

The objectives of offering this course are

1. to introduce architecture and design concepts underlying modern complex VLSI circuits and system-on-chips.
2. to do synthesis of digital VLSI systems from register-transfer or higher level descriptions in hardware design languages.
3. to design actual VLSI subsystems from high level specifications.
4. to learn layout, stick diagrams, fabrication steps, static and switching characteristics of inverters.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze complex microelectronics circuits and systems.
2. demonstrate the ability to design a system, component or process as per needs and specifications.
3. demonstrate the modelling of digital system using hardware description language.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
b	Design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data	2
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints	3
d	Solve problems related to electronics engineering in interdisciplinary projects	2

1-Weakly correlated **2-Moderately correlated** **3-Strongly correlated**

COURSE CONTENT

Introduction to VHDL: HDL introduction, capabilities, hardware abstraction, HDL module structure: VHDL and Verilog module, Operators: logical, relational, arithmetic, shift and rotational, Data types : VHDL and Verilog, Description types : behavioural, structural, switch level, data flow, mixed type, mixed language, simulation and synthesis, VHDL and verilog comparison.

Design Concept and Data-flow Description: Structure of Data-flow Description: Signal declaration and signal assignment statements, concurrent signal assignment statements, constant declaration and assignment statements, assigning a delay to the signal assignment statements. Conditional signal assignment (when…else), selective signal assignment (with…select), common programming errors: VHDL and verilog programming errors.

Behavioural and Structural Description: Behavioural Description: Structure of behavioural description, variable assignment statement, sequential statements for VHDL: IF statement, signal and variable assignment, case statement, loop statement, procedures and functions statements, package declaration, VHDL and verilog programming errors. Structural Description: Organization of structural design, binding methods, state machine (Moore Mealy machines) state diagrams, approach to the design of synchronous sequential finite state machines, component declaration and instantiation, examples using generate statements following HDL, VHDL and verilog.

Switch-Level and Mixed Type Description: Switch-Level Description: Single NMOS and PMOS switches: NMOS and PMOS switch description for VHDL, serial and parallel combinations of switches. Switch level description of: Primitive gates, combinational logics, sequential circuits, CMOS and bidirectional switches. Mixed Type Description: User defined data types in VHDL, implementation of arrays, mixed type description examples.

VHDL and Logic Circuit Processing: VHDL file processing: Concept and built-in procedures for file handling. Programmable Logic Devices: Complex programmable logic devices (CPLDs) and Field Programmable Gate Arrays (FPGA), applications of CPLD's and FPGAs. Testing of logic circuits: Testing combinational logic, stuck-at-fault, complexity of a test set, path sensitizing, testing of sequential circuits, built in self test.

Text Books

1. HDL Programming Fundamentals VHDL and Verilog, Nazeih M. Botros, Thomson Learning Inc.
2. Fundamentals of Digital Logic with VHDL, Stephen Brown, ZvonkoVranesic, Tata McGraw Hill Publishing Company Limited, 2nd Edition.

Reference Books

1. A VHDL Primer,J.Bhasker, 3rd edition, PHI Learning, 2009
2. An Introduction to VHDL from Synthesis to Simulation, Sudhakar Yalamanchi
3. Principal of Digital System Design using VHDL,Charles H.Roth, Lizy Kurian John , Bostan, Thomson Book.
4. VHDL, D.L. Perry, 4th edition Tata McGraw Hill Publications, 2002.

ET405 DIGITAL SYSTEM DESIGN AND VERY LARGE SCALE INTEGRATION LAB

Teaching Scheme: 02P **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50

Minimum 10 experiments from list shall be performed to cover entire curriculum of course ET405. Perform any 9 experiments from experiment 1 to 12. Experiment 13 is compulsory. Perform experiments using software and verify them on FPGA/CPLD board. The list given below is just a guideline.

LAB COURSE CONTENT

1. Realization of all 2 input and 3 input Logic Gates.
2. Realization of 4 bit binary to Gray converter/ BCD to seven segment decoder.
3. Realization of 4 to 1 multiplexer/ 8 to 1 multiplexer.
4. Realization of 2 to 4 decoder/3 to 8 decoder.
5. Design a full adder circuit using dataflow, behavioral, structural and mixed type of description.
6. Realization of SR, D, JK and T flip-flop.
7. Realization of 4 bit binary up down counter with Asynchronous reset.
8. Design of Sequence Detector / Generator (Mealy and Moore Machines).
9. Verify any two combinational circuits using VHDL.
10. Realization of 4 bit BCD counter with Synchronous reset.
11. Realization of 4 Bit Left/Right Shift Register(SISO and PIPO).
12. Design of Arithmetic and Logical Unit (to Perform – ADD, SUB, AND, OR, 1's compliment, 2's Compliment, Multiplication and Division).
13. Design a simple processor which can perform simple operations like ADD, MOVE, LOAD, SUB etc.

SH 401 ENTREPRENEURSHIP AND BUSINESS PLANNING

Teaching Scheme: 02L + 00T **Credit:** 02
Evaluation Scheme: 8 ISE1 + 8 ISE2 + 4 ISA + 30 ESE **Total marks:** 50
Duration of ESE: 2 Hrs

COURSE DESCRIPTION

The course focuses on awareness of entrepreneurs and its different aspects. This course will cover details about small scale enterprises and family business. It gives overview of entrepreneurship.

COURSE OBJECTIVES

The objectives of offering this course are to

1. make students aware of the role of entrepreneurs and importance of entrepreneurship.
2. understand the basic concept of small scale enterprises.
3. enable students to enhance their own family business.
4. acquire the different traits of entrepreneurs

COURSE OUTCOMES

On successful completion of this course the students will be able to

1. apply the knowledge of entrepreneurship.
2. prepare project report to start own enterprise.
3. run and enhance their own family business.
4. utilize the new policies of entrepreneurship.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION:

PO No.	Pos	Level of co-relation
f	understand and adapt universal skills and culture without losing human and ethical values.	3
i	recognize the need for and have the ability to engage in, perpetual learning by working on projects for which they have no prior experience and by adapting latest advancement in technology and concepts.	2
j	interpret and update with contemporary issues affecting engineering industry.	2
k	manage the project under execution effectively and professionally using the techniques, skills, and modern engineering tools necessary for engineering practice.	2
m	maintain quality, timeliness and continuous improvement.	3

1-Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Entrepreneur and Entrepreneurship: Evolution of the term entrepreneur, definition, entrepreneurs and managers, traits of a true entrepreneur, characteristics of a successful entrepreneur, classification of entrepreneurs, functions of an entrepreneur, problems faced by entrepreneurs. Concepts of entrepreneurship, importance of entrepreneurship, myths of

entrepreneurship, stages in the entrepreneurial process, barriers to entrepreneurship, socio-economic origins of entrepreneurship, environmental factors affecting entrepreneurship, views of Schumpeter.

Modern Small Business Enterprises: Role of small-scale industries, concepts and definitions of SSI, business opportunities in various sectors, formalities for setting up of a small business enterprise, government policy and development of the small-scale sector in India, growth and performance of small scale industries in India, problems for small-scale industries, prospects of the small-scale industries in a free economy, role of FICCI, CII and chamber of commerce. Sickness in small business enterprises: definition, criteria to identify sickness, causes, symptoms, cures for SSI sickness.

Project Identification, Formulation: Meaning of project, project identification, project classification, internal and external constraints, project objectives, desk research and techno-economic survey, project life cycle. Project formulation: need concept significance and elements of project formulation, feasibility analysis. Project report, project selection, appraisal format, project formulation and financial institutions and government.

Family Business: Importance of family business, various types of family businesses, succession in family business, management development plan in family business, how to save the family business.

Management in Small Business: Organization life cycle, strategic management- Concept and Process, Importance of financial management in small business, sources of financing, working capital management- Meaning, Concepts, Classification and Importance of working capital, importance of marketing in small business, customer relationship management.

Recent Policies for Entrepreneurship: Standup India, Startup India, National Policy on Entrepreneurship 2015- policy framework for entrepreneurship.

Text Books:

1. Entrepreneurship Development Small Business Enterprises, Poornima M Charantimath, Pearson, 1st edition Reprint, 2005.
2. Entrepreneurial Development, C.B. Gupta, Srinivasan N.P., Sultan Chand and Sons Publications, 5thedition, 2008.
3. Dynamics of Entrepreneurship Development and Management, Vasant Desai, Himalaya, 1st edition, 2009.

Reference Books:

1. Entrepreneurship, Robert D. Hisrich, Michal P. Peters, Tata McGraw-Hill, 7th edition, Jan 1, 2007.
2. Patterns of Entrepreneurship, Jack M. Kaplan, Willey Publications, 4th edition, 2013.
3. Entrepreneurship Development and Project Management, Neeta Baporikar, Himalaya, 2nd edition, 2011.
4. Entrepreneurship Development, Cynthia L. Greene, Cenage Learning, 4th edition, 2008.

ET402 SATELLITE AND MOBILE COMMUNICATION

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course will explore the basic concepts of satellite communication and mobile communication. Students will understand and learn various concepts of communication systems and information theory. In this course, more emphasis is given on analysis of performance of satellite communication and mobile communication systems. This course is designed to lay the foundation for further studies in areas such as advanced communication systems.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic electronics engineering, analog and digital communication systems

COURSE OBJECTIVES

The objectives of offering this course are

1. to learn and understand basic concept of satellite communication systems.
2. to learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
3. to learn and understand architecture of Global Systems for Mobile (GSM) and Code Division Multiple Access (CDMA) system..
4. to understand mobile management, voice signal processing and coding in GSM and CDMA system

COURSE OUTCOMES

On successful completion of this course the students will be able to

1. prepare the link budget of satellite communication system.
2. analyze radio channel and cellular capacity.
3. apply concepts of GSM and CDMA system.
4. evaluate performance of a mobile communication system.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No	POs	Level of co-relation
a	apply knowledge of basic sciences, mathematics and basic engineering courses as appropriate to the field of electronics and telecommunication engineering.	3
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	2

1-Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Introduction: Introduction – Frequency allocations for satellite services, Intelsat, polar orbiting satellites Kepler's first, second and third law, definitions of terms for earth orbiting satellites , orbital elements – Apogee and Perigee heights, orbital perturbations, and sun-synchronous orbit.

Geostationary Satellites and Polarization: Earth eclipse of satellite, sun transit outage, launching of geostationary satellites, atmospheric losses, ionospheric effects, rain attenuation. Antenna polarization, polarization of satellite signals, cross polarization discrimination, ionospheric depolarization rain depolarization, ice depolarization

Satellite Antenna: Antenna basics, aperture antennas. Antenna look angles, antenna mount, limits of visibility parabolic reflectors, offset feed, double reflector antenna. Introduction, equivalent isotropic radiated power, transmission losses, the link power budget equation, system noise, carrier to noise ratio, the uplink and downlink process , effects of rain, combined uplink and downlink C/N ratio

Wireless Communications: Evolution of mobile radio communication, mobile radio systems around the world wireless communication system, trends in cellular radio and personal communications, second generation (2G) cellular networks, third generation (3G), fourth generation (4G), fifth generation (5G), wireless networks, Wireless Local Loop (WLL) and Wireless Local Area Networks (WLANs)

Cellular Concepts: Introduction, frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving coverage and capacity in cellular system, GSM-services and features, system architecture, radio system, GSM channel types, frame structure, signal processing in GSM.

CDMA Digital Cellular Standards: Introduction, frequency and channel, specifications, forward CDMA channel, reverse DMA channel. Green technology, energy optimization.

Text Books

1. Satellite Communications, D. Roddy, Tata McGraw-Hill, 4th edition.
2. Wireless Communications-Principles and Practice, T. Rappaport, 2nd edition.
3. Mobile Communications, Jochen Schiller, Pearson Education, 2nd edition, 2001

Reference Books

1. Satellite Communications, Robert M.Gagliardi, CBS, Delhi, 1st edition, 2007
2. Satellite Communications, Timothy Pratt,Wiley 2nd edition, Pearson, 2013
3. Mobile Cellular Telecommunication Systems, William C.Y. LEE, McGraw-Hill 2nd edition, TMH, New Delhi, 1995.

ET406 SATELLITE AND MOBILE COMMUNICATION LAB

Teaching Scheme: 02P; Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

Twelve experiments shall be performed to cover entire curriculum of course ET403. The list given below is just a guideline.

1. To set up direct link of satellite.
2. To set up active satellite link.
3. To study satellite transponder.
4. To set up satellite communication link.
5. To transmit and receive function generator waveforms through Satellite link.
6. To understand the shape of earth. Measurement of latitude and longitude.
7. To understand the principle of PRN code in GPS.
8. To establish PC-to-PC communication using satellite communication link.
9. To establish the link between GPS satellite and GPS trainer.
10. To study mobile transmitter and receiver.
11. To perform GSM architecture.
12. To perform cordless telephone system.
13. To perform CDMA.
14. To perform Voice Over Internet Protocol (VOIP).
15. Field visit in the organisation related syllabus.
16. Case study of GSM system.

Note

- **ICA –**Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition, it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format**(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

ET403A DIGITAL IMAGE PROCESSING

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:**100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course presents the fundamentals and mathematical models in digital image processing, develop time and frequency domain techniques for image enhancement, expose the students to current technologies and issues and develop image processing applications in practice.

DESIRABLE AWARENESS/SKILLS

Knowledge of basics of digital signal processing

COURSE OBJECTIVES

The objectives of offering this course are

1. to learn the fundamental concepts of digital image processing,
2. to study basic image processing operations,
3. to understand image analysis algorithms,
4. to expose students to current applications in the field of digital image processing.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze the fundamental steps in digital image processing.
2. apply the image transforms in digital image processing.
3. design a system using different image processing techniques.

RELEVANCEOF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
a	manage the project under execution effectively and professionally using the techniques, skills, and modern engineering tools necessary for engineering practice.	3
b	assist in research and development activities.	3

1-Weakly correlated **2- Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Digital Image Fundamentals: Introduction and examples of fields that use digital image processing, elements of visual perception, a simple image model, fundamental steps and components in digital image processing, image sensing and acquisition, sampling and quantization, basic pixel relationship, image file formats.

Image Transforms: Introduction, need for transform, Fourier transform, Two Dimentional (2D) Discrete Fourier Transform (DFT), properties of 2D-DFT, Walsh transform, Hadamard transform, Haar transform, Discrete Cosine Transform (DCT), Karhunen-Loeve (KL) transform.

Image Enhancement: Enhancement in spatial domain, basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothening and sharpening spatial filters. enhancement in frequency domain: smoothing and sharpening using frequency domain filters.

Image Restoration and Colour Image Processing: Image degradation model, noise models, restoration in presence of noise in spatial domain, periodic noise reduction by frequency domain filtering, linear filtering, inverse filtering, wiener filtering, geometric mean filter. Color image processing: color fundamentals, colour models, color transformations, smoothing and sharpening, image segmentation based on color.

Image Compression: Image compression fundamentals, coding redundancy, spatial and temporal redundancy, irrelevant information, measuring image information, fidelity criteria, image compression models, image compression standards, Joint Phographic Expert Group (JPEG) baseline coder decoder. Basic compression methods, Huffman coding, run-length coding, predictive coding,

Image Analysis and Image Processing Applications: Morphological image processing: dilation, erosion, opening and closing on binary images. Segmentation: point, line and edge detection, thresholding, region based segmentation. Boundary representation: boundary descriptors, regional descriptors. Applications: character recognition, fingerprint recognition, remote sensing, medical imaging, electron microscopy.

Text Books

1. Digital Image Processing, R.C.Gonzalez and R.E.Woods, Pearson Education, 3rd edition, 2009.
2. Digital Image Processing using Matlab, R.C.Gonzalez , R.E.Woods and S.L.Eddins, Mc Graw Hill, 2nd edition, 2010
3. Digital Image Processing, S.Jayaraman, S Esakkirajan and T. Veerakumar, Mc Graw Hill Education,2009.

Reference Books

1. Fundamentals of Digital Image Processing, A. K. Jain, Prince-Hall India, 7th edition 1989.
2. Digital Image Processing, W.K.Pratt , John Wiley and Sons, 3rd edition,2001.
3. Image Processing, Analysis and Machine Vision, M. Sonka, V. Hlavac,R. Bole, 2nd edition, 1999.

ET407A DIGITAL IMAGE PROCESSING LAB

Teaching Scheme: 02P; Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+25 ESE **Total Marks:** 50

Minimum twelve experiments shall be performed to cover entire curriculum of course ET403A. The list given below is just a guideline. All experiments shall be performed using C/Matlab/Labview.

1. Study of different file formats e.g. Bit MaP(BMP), Tagged Image File Format (TIFF) and extraction of attributes of BMP.
2. Study of statistical properties- mean, standard deviation, profile, variance and histogram plotting.
3. Histogram equalization and modification of the image.
4. Gray level transformations such as contrast stretching, negative, power law transformation.
5. Spatial domain filtering- smoothing and sharpening filters.
6. DCT / IDCT of given image.
7. Edge detection
8. To compute different image transforms like DCT, Haar, KL etc.(any two)
9. To perform image compression.
10. Creating noisy image and filtering using MatLab.(using any two filters)
11. To perform dilation and erosion operation on image
12. To perform opening and closing operation on image.
13. To extract three color components red, green and blue from an RGB image.
14. Converting color image to black and white image and vice versa.
15. Performing thresholding operation.

Note

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical andits regular assessment. In addition; it shall be based on knowledge/skill acquired and recordsubmitted by student (journal) based on practical performed by him/her. The performanceshall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based onperformance in one of the experiments performed by student in the semester followed bysample questions to judge the depth of understanding/knowledge or skill acquired by thestudent. It shall be evaluated by two examiners out of which one examiner shall be out ofinstitute.

ET403B BROADBAND COMMUNICATION

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course presents the actual concepts of broadband communication networks including Integrated Service Digital Network (ISDN) and Asynchronous Transfer Mode (ATM) networks to support multimedia applications in networking

DESIRABLE AWARENESS/SKILLS

Knowledge of basic electronics engineering, analog and digital communication systems

COURSE OBJECTIVES

The objectives of offering this course are

1. to learn and understand basic concept of broadband communication systems.
2. to learn and understand packet.
3. to learn and understand ISDN protocol architecture and system.
4. to understand ATM management and, ATM cell processing.

COURSE OUTCOMES

On successful completion of this course the students will be able to

1. analyze the ISDN system.
2. demonstrate the analysis of X.25.
3. apply concepts of ATM cells and ATM system.
4. evaluate performance of ISDN and ATM system.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No	POs	Level of co-relation
a	apply knowledge of basic sciences, mathematics and basic engineering courses as appropriate to the field of electronics and telecommunication engineering.	3
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	3

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Packet Switch WAN Protocols: Introduction, X.25 protocol, packet formats, sequence of events, frame relay: frame relay protocols, architecture, comparison with X.25 protocol, frame mode. Call control, call control protocol. Frame relay congestion control, congestion, approaches, traffic rate management, explicit, congestion avoidance, implicit congestion control.

ISDN: Introduction to ISDN, Integrated Digital Network (IDN), Principles of ISDN, Evolution of ISDN, ISDN standards, architecture, transmission structure, user network interface configuration, ISDN protocol architecture, ISDN, connection, addressing. Inter working ISDN –

ISDN, ISDN – Public Switched Telephone Network (PSTN), ISDN – Circuit Switched Public Data Network (CSPDN).

Broadband Integrated Service Digital Network (B-ISDN): Architecture and standards B-ISDN services conversational, messaging, retrieval, distribution, business and residential requirements. B-ISDN protocol: user plane, control plane, physical layer, line coding, transmission structure, Synchronous Optical Network (SONET) requirement, signal hierarchy, system hierarchy, frame format pointer adjustment

ATM: Overview, virtual channels (VC), virtual paths (VP),VP and VC switching, ATM cells, header format, generic flow control, header error control, transmission of ATM cells, adaptation layer, ATM Adaptation Layer (AAL) services and protocols. ATM switching building blocks, ATM cell processing in a switch, matrix type switch, input, output buffering, central buffering, and performance aspects of buffering switching networks.

ATM Traffic and Congestion Control: Requirements for ATM traffic and congestion control, cell-delay variation, ATM services, categories, traffic and congestion control framework, traffic control, congestion control,

Text Books

1. ISDN and Broadband ISDN with frame Relay and ATM, Williams Stallings, PHI, 4th edition, 2004.
2. Data Communication and Networking, Behrouz Forouzan, TMH, 4th edition, 2007.
3. Broadband Communication, Balaji kumar, McGraw-Hill, 2nd Revised edition, 2003.

Reference Books

1. Broadband Internet Network, Mischa Schwartz, PHI, 2006.
2. Digital Telephony, Johan C. Bellamy, Johan Wiley, 3rd edition, 2002.

ET407B BROADBAND COMMUNICATION LAB

Teaching Scheme: 02P; Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

In this laboratory course emphasis is on the study and analysis of various concepts in Switching ISDN and ATM. Twelve experiments shall be performed to cover entire curriculum of course **ET403**. The list given below is just a guideline.

1. To perform X.25 protocol, packet Formats, sequence of events,
2. Introduction to Electronic Private Automatic Branch Switching Exchanges
3. Study of working of a Manual and Automatic matrix switching Network,
4. Learning Broadband communication and its various protocol and connection using simtel Netsys software.
5. To observed different types of ISDN interfaces.
6. To set basic configuration of ISDN system using Emulator.
7. To observed ISDN Telephones, terminal, adapter and analog Telephones
8. To analyze simple Trace using Protocol Analyzer after establishing, voice communication between two ISDN telephones.
9. To observe different types of Numbering in ISDN System.
10. To observe point to point/multipoint connections in ISDN System.
11. To observe filtering in ISDN analyzer.
12. To observe SDN Telephone Features.
13. To observed f Euro-/SDN ETSI standards with Fault Finding.
14. Case study on ATM system.

Note

- Above experiment number may be performed by visiting BSNL, mobile transmitter, different Broadband service provider and maintain proper documentation.
- **ICA –**Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance oral by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

ET403C EMBEDDED SYSTEMS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

Contents deals with the history of embedded systems, recent trends and design challenges in embedded systems. It covers design of general purpose processors with finite state machine concepts. It emphasizes system architecture of Advance Reduced Instruction Set Computer (RISC) Machine (ARM) and ARM families. It also contains interfacing and programming with peripherals of LPC2148 microcontroller (ARM based). Introduction and basic concepts of Real Time Operating System (RTOS) (µC/OS-II).

DESIRABLE AWARENESS/SKILLS

Knowledge of basic microcontrollers/microprocessors and digital system design.

COURSE OBJECTIVES

The objectives of offering this course areto impart strong foundation of embedded system ARM core controllers in the area of

1. Microcontroller and Microprocessor
2. Real Time Operating System

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
2. demonstrate the application of general purpose processors using finite state machines.
3. apply the knowledge of architecture of ARM processors and its programming.
4. implement the real time embedded systems using RTOS

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No	Pos	Level of co-relation
b	Design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data.	3
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints.	2
d	Solve problems related to electronics engineering in interdisciplinary projects.	1

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Introduction to Embedded Systems: Introduction to embedded systems, history, design challenges - optimizing design metrics, time to market concept, top-down design process and

technology, applications of embedded systems and recent trends in embedded systems, processor technology, IC technology and design technology, trade-offs in embedded systems.

Custom Single-Purpose Processor Design: Design of general purpose processor: controller and data path design, concept of Finite State Machine (FSM), Real Time (RT) level processor design using FSM, optimization, design of custom single purpose processors like: generating fibonacci numbers output design, Greatest Common Divisor (GCD) design, elevator controller design etc.

System Architecture: Introduction to Advance Reduced Instruction Set Computer (RISC) Machine (ARM) embedded systems - RISC versus Complex instruction set computer (CISC) machines, ARM design philosophy, ARM processor fundamentals, ARM extension family, operating modes, pipeline, memory management, bus architecture, exception handling and interrupt structure.

LPC 2148 Interfacing and Programming: Brief introduction to ARM-7 processor LPC2148 block diagram, need of interfacing, interfacing techniques, basic embedded C programs for GPIO and interfacing of different devices like switches, keypad, Light Emitting Diode (LED), Liquid Crystal Display (LCD), Relay, Stepper Motor. Study and programming of on-chip peripherals like timers, counters, on-chip Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Universal Asynchronous Receiver/Transmitter (UART), Real Time Clock (RTC) modules, Watch Dog Timer (WDT), phase locked loop (PLL), Pulse Width Modulator (PWM).

Communication Protocol: Basic protocol concept, study of protocols like Serial Peripheral Interface (SPI), Inter-Integrated Circuits (I2C), Controller Area Network (CAN), Ethernet. Wireless Protocols: Infrared Data Association (IrDA), Bluetooth, IEEE802.11 (Wi-Fi), ZigBee, RF modules, etc. Case study of Complementary Metal Oxide Semiconductor (CMOS) camera (without codes), requirement specification, different ways to design of camera.

Real Time Operating System (RTOS) Concept: Need of RTOS in embedded system software, foreground/background systems, multitasking, context switching, IPC, scheduler policies, architecture of kernel, task scheduler, ISR, semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS. Introduction to µC/OS-II RTOS, study of kernel structure of µC/OS-II, synchronization in µCOS-II, inter-task communication in µC/OS-II, memory management in µC/OS-II, porting of RTOS of ARM 2148, Application developments using µC/OS-II.

Case Studies of Programming with RTOS: Case study for automatic chocolate vending machine using µC/OS RTOS.Case study of an embedded system for an adaptive cruise control system in car.

Text Books

1. Embedded System Design: A Unified Hardware/Software Introduction, Frank Vahid and Tony Givargis, John Wiley and Sons, 3rd edition, 2006.
2. Embedded Systems: Architecture, Programming, and Design by Raj Kamal, Tata Mc-Graw Hill Education, 3rd edition, 2014.
3. Embedded/Real-Time Systems: Concepts, Design and Programming, Dr. K.V.K.K. Prasad, Dreamtech Press, 1st edition 2003.

Reference Books

1. ARM System Developer's Guide, Andrew Sloss, Morgan Kaufmann Pubilsher, 1st edition, 2004.
2. ARM System-on-Chip Architecture, Steve Furber, Pearson Publication, 2nd edition, 2015.
3. LPC 2148 Datasheet
4. µC/OS-II, The Real-Time Kernel, Jean J. Labrosse, Indian Low Price Edition, 2002.

ET407C EMBEDDED SYSTEMS LAB

Teaching Scheme: 02P; Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs.

Minimum ten experiments shall be performed to cover entire curriculum of course ET403C from 1 to 12. The experiment based on µC/OS-II is compulsory. The list given below is just a guideline. All experiments must be performed using Embedded C (software-Keil/SCARM) on LPC 2148 evaluation board.

1. To study programming of embedded C.
2. Program for digital output (LEDs and buzzer interfacing)
    a. Program to blink LEDs
    b. Program to turn ON LEDs one by one in forward direction
3. Program for digital input with switch and relay interfacing
    a. When switch is pressed turn ON the buzzer, otherwise turn ON relay switch
4. Program for stepper motor interfacing
    a. Program to rotate stepper motor with different step angle in clockwise direction
    b. Program to rotate stepper motor with different step angle in anticlockwise direction
5. Program for 16x2 Text LCD interfacing (2 turns)
    a. Program to display a text "EMBEDDED SYSTEMS" on character LCD
6. Program for 4x4 matrix keypad interfacing
7. Program for on-chip analog to digital conversion
8. Program for interfacing on-chip digital to analog conversion
    a. To generate square wave of any frequency and amplitude using DAC
    b. To generate triangular wave of any frequency and amplitude using DAC
    c. To generate trapezoidal wave of any frequency and amplitude using DAC
9. Program for external interrupt.
10. Program for timer configuration and led blinking using timer delay.
11. Program for timer interrupt.
12. Program for serial communication using UART0.
13. Experiments based on µC/OS-II RTOS (2 turns).
    a. Implement multitasking with two separate LED blinking tasks

Note:

• **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and recordsubmitted by student (journal) based on practical performed by him/her. The performanceshall be assessed experiment wise using internal continuous assessment format **(S 10).**

• **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

ET403D BIOMEDICAL ENGINEERING

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course provides necessary background to understand the history and appreciate the field of biomedical engineering. It includes introduction to the biomedical instrumentation and measurement. The anatomy and function of heart, the human nervous and muscular system, human respiratory system and its measurements, imaging techniques and telemetry system. This course is designed to introduce the students to the basic principles and applications of sensors, medical oscilloscopes, analog and digital instruments. This course provides instruction in the theory and application of biomedical instruments.

DESIRABLE AWARENESS/ SKILLS

Knowledge of basic electronics instrumentation, electronics measurement, component devices and instrument technology

COURSE OBJECTIVES

The objectives of offering this course are

1. to impart fundaments of biomedical instrumentation.
2. to make students familiar with application of biomedical engineering.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. demonstrate the knowledge of the modern health care system and role played by biomedical engineers.
2. evaluate the sources of biomedical signals, basic medical instrumentation system.
3. analyze man-instrument system and implement the problems encountered in attempting to obtain measurement from living body.

RELEVANCE OF PROGRAM OUTCOMES (PO_s) AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
b	Design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data.	2
k	Manage the project under execution effectively and professionally using the techniques, skills, and modern engineering tools necessary for engineering practice.	2
l	Assist in research and development activities.	3

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlate**

COURSE CONTENT

Biomedical Engineering: The evolution of modern health care system, modern health care system, role played by biomedical engineers, recent advances in biomedical engineering, prosthetics, orthopedic, neural, tissue engineering, stem cell research, professional status of biomedical engineering, professional societies, the American institute for medical and biological engineering, IEEE engineering in medicine and biology society, the biomedical engineering society.

Introduction to Human Body and Related Measurement: Basics of biomedical instrumentation system, anatomy and physiology of the human body, physiological systems of the body, sources of biomedical signals, basic medical instrumentation system. Transducers and sensors: pressure transducers, transducer for temperature measurement, displacement, position and motion transducers, photoelectric transducers, optical fiber sensors, biosensors, smart sensors.

Cardiovascular System: Heart and cardiovascular system, heart, blood pressure, characteristics of blood flow, heart sound. cardiovascular measurement: electrocardiography, Electrocardiogram (ECG) amplifiers, electrodes and leads, ECG recorder principles, types of ECG recorder, single channel, three channel, vector electrocardiographs, electrocardiograph system for stress testing, electrocardiograph for computer processing, continuous ECG recording .measurement of blood pressure, measurement of blood flow and cardiac output, measurement of heart sounds, pacemakers.

Biomedical Recorders: Electrocardiograph, block diagram of electrocardiograph, ECG leads, microprocessor based ECG machine, multi-channel ECG machine, Vector Cardiograph (VCG), Phonocardiogram (PCG) machine, origin of heart sounds, microphones for phonocardiography, amplifiers for phonocardiography, writing method for phonocardiography, Electroencephalogram (EEG) machine, Electromyogram (EMG) machine.

X-ray Machines and Digital Radiography: Basis of diagnostic radiology, generation of ionizing radiation, detection of radiation, instrumentation for diagnostic X ray, visualization of X -ray, fluoroscopy, X-ray films, image intensifier, nature of X-ray, production of X-rays, X-ray machine, visualization of X-ray machines, portable and mobile X-ray units, digital radiography.

Ultrasonic Imaging Systems and Others: Diagnostic ultrasound, physics of ultrasonic waves, medical ultrasound, basic pulse-echo apparatus, A-scanner, B-scanner, real time ultrasonic imaging system, biological effects of ultrasound, audiometer and audiometric tests and types, defibrillator, pacemakers, computerized monitoring system, grounding and safety.

Text books

1 Bio-medical Instrumentation, R. S. Khandpur, 2nd edition, TMH, 2012.
2 Biomedical Instrumentation and Measurements, Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd edition,PHI1980.
3 Medical Instruments, D. S. Chaudhari,1999.

Reference books

1. Introduction to Biomedical Engineering, John D. Enderle and Bronzino, 3rd edition, AP, 2014.
2. Biomedical Signal Analysis: A Case study approach, R. M. Rangayyan, IEEE Press, 2001.

ET407D BIO-MEDICAL ENGINEERING LAB

Teaching Scheme: 02P, Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50

Minimum twelve experiments shall be performed to cover entire curriculum of course ET403D.The list given below is just a guideline.

1. Study different biomedical electrodes.
2. Measurement of Blood Pressure by direct and indirect method.
3. ECG amplifier to measure amplitude and frequency
4. Record of PQRST waveform using ECG machine.
5. Measurement of pulse rate.
6. Study of measurement of temperature of human body direct and indirect method.
1. Study of pace maker unit to compare the operation of heart with the normal functioning of heart.
7. Study of audiometer, audiogram.
8. Study of blood cell counter to measure cell counts.
9. Study of spectrophotometer.
10. Use of ultrasound in medical electronics.
11. Study of generation of ionizing radiation.
12. Study of visualization of X -ray, fluoroscopy.
13. Study of temperature telemetry system to measure the received data.
14. Study of grounding and safety issues.
15. Three visits to hospital/ medical college are mandatory for the study of instruments which are included in above practical.

Note:

- **ICA –**Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition, it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE:** Oral examination based on experiments/assignments covered in ET403D.

ET404A SEMICONDUCTOR POWER DEVICES AND DRIVES

Teaching Scheme: 03L+00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course is designed to lay the foundation for further studies in areas such as power electronics, its applications and advanced electric drives etc.This course will explore the basic concepts of semiconductor devices, its switching characteristics. Students will understand and learn various types of semiconductor devices, their switching characteristics, circuits, protection and applications. In this course, more emphasis is given on analysis and design of drives.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic electrical engineering, electric and magnetic circuit concepts, electric machines fundamentals.

COURSE OBJECTIVES

The objectives of offering this course are

1. to make strong foundation of semiconductor power devices and its application in drives.
2. to strengthen ability of students to analyse and design power electronic circuits.
3. to make students familiar with applications of semiconductor power devices in other areas of electric power control.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze the switching characteristics of diodes, thyristors, Bipolar Junction Transistor (BJTs), Metal Oxide Semiconductor Field Effect Transistor (MOSFETS), Insulated Gate Bipolar Transistor (IGBTs) etc.
2. design thyristor triggering, commutation, protection circuits.
3. analyze and design rectifiers, choppers, inverters, converters circuits operation.
4. apply the knowledge of working of direct current (DC) drives.
5. apply the knowledge of working of alternating current (AC) drives.

COURSE CONTENT

Power Electronic Systems: An overview of power electronic development, power electronic systems, power semiconductor devices, power electronic converters, power electronic applications. Thyristor: construction, principle of operation, static anode-cathode characteristics, two transistors model of Silicon Controlled Rectifier (SCR), derivation of anode current, turn on methods, dynamic turn-on switching characteristics, turn-off mechanism, gate triggering circuits using resistor (R), Resistor-Capacitor (RC) and Uni Junction Transistor (UJT) triggering circuit, protection circuits of SCR overvoltage, over current protection, dv/dt and di/dt protection, non-linear surge suppressor, gate protection. Other Power Devices: Diode for Alternating Current (DIAC), Triode for Alternating Current (TRIAC), Insulated Gate Bipolar Transistor (IGBT), Gate Turn-off Thyristor (GTO), structure, working principle, electrical characteristics and applications.

Phase Controlled Rectifiers: Control techniques – phase angle control, extinction angle control, Pulse Width Modulation (PWM) control; working principle of single phase half wave controlled rectifier, single phase half controlled and full controlled bridge rectifier with R and R-

L load. Three phase controlled converters: three pulse converters half and full controlled rectifiers with R and R-L load operating modes (continuous and discontinuous conduction modes).

DC Chopper: Basic chopper classification, control strategies – time ratio control and current limit control, operating principle of step down, step up chopper, step up/down chopper, chopper configuration – first quadrant, second quadrant, third quadrant and fourth quadrant operations.

Inverters: Introduction, classification of inverters, working of series and parallel inverter, single phase half and full bridge inverters with R and R-L load, square wave, quasi-square wave and sinusoidal PWM switching.

AC Regulators and Uninterruptable Power Supply (UPS) AC Regulators*:* Working principle single phase half and full wave AC control with R and R-L load. **UPS*:*** basic principle, different configurations/ types of UPS, off-line, on-line, line interactive, battery-Ah, back up time.

Drives: Concept of electric drive, single phase DC drives: half wave converter drives, full converter drives, dual converter drives. AC drives, induction motor drives, speed control of induction motor.

Text Books

1. SCR MANUAL, A. P. Connolly, R. W. Fox, F. B. Golden, D. R. Gorss, S. R. Korn, R. E. Locher, S. J. Wu, General Electric, 5th edition, 1972.
2. Power Electronics: Converters, Application and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley and Sons Inc., 3rd edition, 2003.
3. Power electronics, P. C. Sen, Tata McGraw Hill, 1st edition, 30th reprint, 2008.

Reference Books

1. Power Electronics: circuits, devices and applications, M. H. Rashid, Elsevier, 3rd edition, 2011.
2. Power Electronics, M. S. Jamil Asgher, Prentice Hall of India Pvt. Ltd, New Delhi,1st edition, 2005
3. Modern Power Electronics and AC drives, B. K. Bose, PHI, 1st edition, 2013.
4. Power Electronic System Theory and Design, Jai P. Agrawal, Pearson, 1st Impression, 2006.

ET404B ELECTRONICS INSTRUMENTS AND APPLICATIONS

Teaching Scheme: 03L+ 00 T; Total:03 C**redits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course is designed for studies of various measuring instruments. It includes analog instruments,digital instruments, and oscilloscope.This course will explore the basic concept of electronics instruments specification and their applications. Students will understand and learn how to handle electronics instruments, analyze the reflected light energy in fiber installation to determine the existence and location of breaks in the fiber, losses at spices and connector and the total loss of the system.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic electronics engineering.

COURSE OBJECTIVES

The objectives of offering this course are

1. give an understanding of electronic measurement principles.
2. to strengthen ability of students to analyze signals in time domain and frequency domain by using different measuring instruments.
3. to make students familiar with applications of electronic instruments in the world of work.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. apply the basic concept of measurement for the electronic instruments.
2. analyze the various parameters of Cathode Ray Oscilloscope (CRO).
3. demonstrate the knowledge of display devices and different types of electronics instruments.

COURSE CONTENT

Standards of Measurement: Classification of standards, standards of mass, length and volume, time and frequency standards, electrical standards, standards of temperature and luminous intensity, IEEE standers.

Indicator and Display Devices: Basic meter movement, taut baud instrument, electrodynamometer, moving iron type instrument, digital display system and indicators, classification of displays, display devices, Light Emitting Diode (LED), Liquid Crystal Display (LCD), printers, classification of printers, printer character set, drum printer, dot-matrix printers.

Electromechanical Indicating Instruments: Suspension galvanometer, torque and deflection of the galvanometer, permanent magnet moving coil mechanism, DC ammeters, DC voltmeters, voltmeter sensitivity, series type ohmmeter, shunt type ohmmeter, multimeter or Volt-ohm Meter (VOM), calibration of DC instruments, alternating current indicating instruments thermo instruments, electrodynamometers in power measurements, watt hour meter, power- factor meters, instrument transformers. Dual beams Cathode-Ray Oscilloscope (CRO), dual trace CRO, sampling Very High Frequency (VHF) oscilloscope, storage oscilloscope and digital read out oscilloscope.

Analog Instruments: Q-meter, true Root Mean Square (RMS) responding voltmeter, vector voltmeter, vector impedance meter, bolometer-measurement of power, automatic bridges.

Digital Instruments: Introduction, digital frequency meter, frequency meter, digital measurement of time, universal counter, decade counter, electronic counter, digital tachometer, digital Potential of Hydrogen (PH) meter, digital phase meter, digital capacitance meter, radiation pyrometer, infra-red ultrasonic flow transducer.

Frequency Counters and Time-interval Measurements: Simple frequency counter, measurement errors, extending the frequency range of counter, automatic and computing counters. Analyzer: Introduction, wave analyzers, frequency selective wave analyzer, heterodyne wave analyzer, harmonic distortion analyzer, spectrum analyzer.

Fiber Optics Measurements: Introduction, sources and detectors, fiber optic power measuring, stabilized, calibrated light sources, end to end measurement of fiber system loss, optical time domain reflectometer.

Text books

1. Electronics Instrumentation and Measurement Techniques, W. D. Cooper and A. D. Helfrick, 3rdedition, Pearson education, 2014.
2. Electronic Instrumentation, H. S. Kalsi, 3rd edition, TMH, 2012.

Reference Books

1. A course in Electrical and Electronics Measurements and Instrumentation, A. K Sawhney, 19th edition, Dhanpat Rai and Sons, 2014.
2. Elements of Electronic Instrumentation and Measurement, Joseph J. C. 4th impression, Pearson education, 2011.

ET404C PHOTOVOLTAIC DEVICES AND SYSTEMS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course is designed to lay the foundation in areas such as advanced renewable energy sources. This course will explore the basic concepts of sun position, solar energy insolation and global energy needs, photovoltaic cells and their characteristics. In this course, more emphasis is given on photovoltaic system components and engineering properties of materials.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic science, semiconductor physics, basic electricity and solar cells.

COURSE OBJECTIVES

The objectives of offering this course are

1. to understand the need of renewable energy sources.
2. to understand and analyze the solar system and solar cells.
3. To design simple photovoltaic systems.

COURSE OUTCOMES

On successful completion of this course students shall be able to

1. correlate the knowledge of the fundamentals of solar energy conversion systems, local and national needs and emerging technologies.
2. follow the interdisciplinary approach for designing Photo Voltaic (PV) systems and implement design with cost analysis.
3. demonstrate a working knowledge of optical systems and photovoltaic engineering.

COURSE CONTENT

Solar Energy Fundamentals: Solar energy, introduction to sun (solar system), solar spectrum, essential subsystems in a solar energy plant, units of solar power and solar energy, concept of solar radiation, irradiation & insolation, phenomena of light and energy, energy from the sun, solar constant, sun tracking systems, merits and limitations of solar energy conversion & utilization.

Solar Cells: Introduction, solar cells fundamentals, solar cell IV characteristics, properties of efficient solar cells, interconnection of solar cells, solar cell efficiency, an analogy for understanding solar cell operation: A partial summary.

Behaviour of solar cells: Structure of solar cells, photovoltaic effect, solar cell parameters (IV curve, Short circuit current, open circuit voltage, fill factor, efficiency, tandem cells), resistive effect, effect of temperature, spectral response.

Photovoltaic System Components: Photovoltaic modules and arrays, efficiency of PV module, series and parallel combination of PV cells,Energy storage devices like Lead-acid batteries, Ni-Cd batteries, Nickel-metal-hydride batteries, rechargeable alkaline manganese (RAM) batteries,

Li-ion and Li-polymer batteries, power conditioning and regulators (Diodes, Regulators, Inverters), Balance of System (BoS) components.

Cost Considerations: Life cycle costing,power economics, social implications, introduction to carbon foot printing, preparing cost sheets for 1 KW solar inverter, 11 W CFL / LED street light, 0.5 Hp solar pumping system.

Photovoltaic Systems Application (preferably MNRE approved models)

Basic examples of photovoltaic systems: Mobile charger, 12 Volts DC fan, 1 Hp / 2 Hp solar pumping system, an utility Interactive System, a 1 KW Solar-Wind Hybrid System, solar street lights, advertisement boards, traffic signals, etc.

Text Books

1. Applied Photovoltaics, by Stuart Wenham and Martin A. Green, James and James science publishers 3rd edition, 2011.
2. Photovoltaic Systems Engineering, Roger A Messenger, Jerry Ventre, CRC Press, 2nd edition, 2003.
3. Energy Technology, S. Rao and Parulekar, B. B., Khanna Publishers, 3rd edition, 13th reprint, 2015.

Reference Books

1. Solar Energy: The physics and engineering of photovoltaic conversion, technology and systems by Olindo Isabella, Klaus Jager.

Website: www.mnre.gov.in – Official website of Ministry of New and Renewable Energy (MNRE), Govt. of India

ET404D INDUSTRIAL AUTOMATION

Teaching Scheme: 03L+00T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 +15 ISE2 +10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

COURSE DESCRIPTION

The course focuses on basic types, levels, strategies of automation. This course covers details about sensors and measurement systems, process control, sequence control, actuators and electric drives.

COURSE OBJECTIVES

1. To understand the role of industrial automation for different processes.
2. To learn about sensors and measurement systems.
3. To understand about different electric drives.

COURSE OUTCOMES

On successful completion of this course the students shall be able to

1. demonstrate the knowledge of basic types, levels and strategies of automation.
2. apply the knowledge of automation in machine control.
3. design the automation system for fast and value added quality product for economic growth through technological development.
4. appreciate the concepts in industrial management and safety.

COURSE CONTENT

Introduction: Introduction to industrial automation and control, definition, types, merits and criticism, architecture of industrial Automation Systems, automation strategies, basic elements of automated system, advanced automation functions, levels of automation, manufacturing plants and operations.

Sensors and Measurement Systems: Introduction to sensors and measurement systems, temperature measurement, pressure and force measurements, displacement and speed measurement, flow measurement techniques, measurement of level, humidity, pH etc., signal conditioning and processing, estimation of errors and calibration.

Introduction to Process Control: Proportional–Integral–Derivative **(**P-I-D) Control, controller tuning, special control structures: feedforward and ratio control, predictive control, control of systems with inverse response, cascade control, overriding control, selective control, split range control, introduction to Supervisory Control and Data Acquisition (SCADA).

Introduction to Sequence Control: Sequence control: scan cycle, Relay Ladder Logic (RLL) syntax, structured design approach, advanced RLL programming. Hardware environment, control of machine tools: introduction to Computer Numerical Control (CNC) machines, analysis of a control loop, introduction to Programmable Logic Controller (PLC) and RLL.

Introduction to Actuators: Flow control valves, hydraulic actuator systems: principles, components and symbols, pumps and motors, proportional and servo valves, pneumatic control systems: system components, controllers and integrated control systems, networking of sensors, actuators and controllers: the fieldbus, the fieldbus communication protocol.

Drives: Introduction, energy saving with adjustable speed drives, step motors: principles, construction and drives, Direct Current (DC) motor drives: introduction, DC-DC converters, adjustablespeed drives, induction motor drives: introduction, characteristics, adjustable speed drives, synchronous motor drives: motor principles, adjustable speed and servo drives, introduction to production control systems.

Text Books

1. Instrument Engineer's Handbook: Process Control,Bela G. Liptak, Chilton Book Company, 3rd edition, 1995.
2. Instrument Engineer's Handbook: Process Control and Optimization, Bela G. Liptak, volume-II, Chilton Book Company, 4th edition, 1995.
3. Automation, Production systems and Computer integrated Manufacturing,Groover, Mikell P, Prentice hall India, 2004.
4. Industrial Engineering and Management, O. P. Khanna, Dhanpat Rai Publication, 4th edition, 1999.

Reference Books

1. Instrument Engineer's Handbook: Process Measurement and Analysis, Bela G. Liptak, Chilton Book Company, 3rd edition, 1995.
2. Instrument Engineer's Handbook: Process Software and Digital Networks, Bela G. Liptak, CRC Press, 3rd edition, 2002.
3. Industrial Automation: Hands-on,Frank Lamb, McGraw Hill Professional, 2013.
4. Computer-based Industrial Controls, Krishan Kant, PHI, 2nd edition, 2004.
5. Robotics and Control, R. K. Mittal and I. J. Nagarath, TMH, 2003.

ET 408 PROJECT PHASE-I

Teaching Scheme:02P; Total: 02 **Credits:** 02
Evaluation Scheme: 50 ICA + 50 ESE **Total Marks:** 100

COURSE DESCRIPTION

The project topic should be selected to ensure the satisfaction of the need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. It should include relevance to needs of society, relevance to value addition to existing facilities in the institute, relevance to industry need, problems of national importance, research and development in various domains. This course is designed to explore the knowledge of design, implementation, experimentation and data analysis. The course develops the ability to work in team as a member and leader.

COURSE OBJECTIVES

The objectives of offering this course are

1. to develop ability to synthesize knowledge and skills previously gained and applied to an in-depth.
2. to suggest, design and execute the technical work in a group.
3. to make students capable to select from different methodologies, methods and forms of analysis to produce a suitable design, and justify their design.
4. to inculcate ability to present the findings of their technical solution in a written report.
5. to inculcate leadership attitude and team spirit.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. demonstrate ability to synthesize knowledge and skills previously gained.
2. suggest, design and implement the technical work using suitable methodology.
3. prepare and present technical report in appropriate format.
4. exhibit leadership attitude and team spirit.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
b	design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data.	3
c	design a component, system or process to meet the specifications and requirements within pragmatic constraints	2
d	solve problems related to electronics engineering in interdisciplinary projects.	2
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	3

g	communicate (oral and written) effectively both individually and within multidisciplinary teams.	2
i	recognize the need for and have ability to engage in, perpetual learning by working on projects for which they have no prior experience and by adapting latest advancement in technology and concepts	2
k	manage the project under execution effectively and professionally using the techniques, skills, and modern engineering tools necessary for engineering practice.	3
l	assist in research and development activities.	1
m	maintain quality, timeliness and continuous improvement	1

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

- The project is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I in odd semester and Phase – II in even semester.
- The project work shall be carried out in the group of 2 – 4 students and shall be carried out in-house i.e. in the department's laboratories and centers **OR** in the industry/organization allotted through department's T & P/project coordinator.
- The project outline (a brief or condensed information giving a general view) on the selected topic should be submitted to the Program Head for approval within two weeks from the commencement of academic year.
- The topic and guide shall be approved in the departmental meeting and informed to student within one week after the submission of outline to enable students to start the topic based work.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define project objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis, Computing and Processing (Hardware and Software) or any other related domain. In case of Industry sponsored project, (co-guide) the relevant application notes, white papers, product catalogues should be referred and reported.
- Each group is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation of the project and phase wise work distribution, and submit the proposal to guide within a month from the date of commencement of classes.
- Around 30–40 % work of the total quantum (i.e. literature survey, system schematic and its design and/or flowchart along with some software development, PCB layout etc.) should be completed by the end of 7^{th}semester.
- **Project Phase – I deliverables** A document report comprising of outline, introduction, literature survey, detailed objectives, project specifications, manual and/or computer aided design, work completed and work to be completed in Project Phase - II, references. In addition, student shall maintain a record of continuous progress (Log Book in the format

given below) duly signed by guide and present as the Project Phase – I deliverable along with report.

Format for Log Book

Sr. No.	Date and Time; Roll numbers of present candidates	Work done (discussion with guide) during the session	Guide's Remark	Dated sign of Guide

EVALUATION SYSTEM

It includesInternal Continuous Assessment (ICA) and End Semester Examination(ESE).
Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by departmental committee consisting of two - three faculty members of the department (one of which shall be guide) appointed by the HoD following the principle of continuous evaluation i.e. project reviews as per academic calendar.
- Examiners shall judge the student on the basis of presentation, deliverables of Project Phase – I described earlier. In case of unsatisfactory performance, committee may recommend repeating the Project Phase – I work and such group shall reregister for this course in next semester.
- The following format may be used for ICA i.e. it shall be used for all reviews and end semester evaluation. Average marks of all reviews and end semester evaluation shall be the final marks of ICA.

Sr No	Title of Project	PRN of Student	Name of Student	Topic selection	Report and Log Book	Work Completed and Its Quality	Punctuality of individual (Guide's evaluative)	Presentation	Depth of understanding (Oral)	Total
				6	10	10	7	7	10	50
1										
2										

Name and Signature of Examiners

End Semester Examination (ESE)

The End Semester Exam for this course shall be based on presentation and demonstration of Project Phase – I deliverables followed by oral examination. It shall be evaluated by two examiners out of which one examiner shall be out of institute and other shall be guide. (If guide is absent at the time of examination, the other examiner shall be the committee member of ICA evaluation)
The following format may be used for assessment; the average of both the examiners shall be the final marks (in case of difference of opinion of examiners).

Sr No	Title of Project	PRN of Student	Name of Student	Topic selection	Report and Log Book	Work Completed and Its Quality	Presentation	Depth of understanding (Oral)	Total
				5	10	10	10	15	50
1									
2									

Name and Signature of Examiners

ET 409 SEMINAR

Teaching Scheme: 02PR Total: 02 **Credit:** 02
Evaluation Scheme: 25 ICA+25ESE **Total Marks:** 50

COURSE DESCRIPTION

The seminar topic should be selected to ensure the satisfaction of the need to establish a direct link between curriculum, recent trends and research/development expected in near future. It should include relevance to needs of society and industry; problems of national importance; research and development in various domains. This course is designed to explore the knowledge of design, implementation, data analysis and comparative study of recent trends and expected research/development in the field of electronics and telecommunication. The course develops the presentation skills and lifelong learning attitude.

COURSE OBJECTIVES

The objectives of offering this course are

1. to develop ability to link between curriculum, recent trends and research/development expected in near future.
2. to explore the ability of comparative study of recent trends or expected research/development in the field of electronics and telecommunication
3. to make students capable to select from different methodologies, methods and forms of analysis.
4. to inculcate communication and presentation skills.

COURSE OUTCOME

On successful completion of this course student shall be able to

1. link between curriculum, recent trends and research/development expected in near future.
2. compare different methodologies, methods and forms of analysis and suggest suitable solution.
3. demonstrate communication and presentation skills.
4. exhibit lifelong learning abilities

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
c	design a component, system or process to meet the specifications and requirements within pragmatic constraints.	2
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	1
g	communicate (oral and written) effectively both individually and within multidisciplinary teams.	3

i	interpret and update with contemporary issues affecting engineering industry	1
l	assist in research and development activities	2

1 - Weakly correlated 2 - Moderately correlated 3 - Strongly correlated

COURSE CONTENT

- It includes detailed study of any one topic apart from curriculum in the field of Electronics, Communication or in the allied field of student's own choice approved by the department; presentation based on topic studied in the presence of other students followed by question and answer session.
- Students shall submit the seminar report on the same topic in the format as approved by the institute and available on its website which shall include literature survey, concept, functional and technical detail, present status, future scope, application, comparison with similar technique and references etc.
- Topic of seminar shall be finalized before last date as specified in academic calendar and it shall not be changed later. However; minute change in the title is permissible with prior approval of HoD.
- **Seminar deliverables** A power point presentation on the topic and seminar report in the specified format which is available on institute's website. In addition, student shall maintain a record of continuous progress (Log Book) duly signed by guide and present as the seminar deliverable along with report.

Format for Log Book

Practical No	Date and Time.	Work done (discussion with guide) during the session	Guide's Remark	Dated sign of Guide

EVALUATION SYSTEM

It includesInternal Continuous Assessment (ICA) and End Semester Examination (ESE). Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by departmental committee consisting of two faculty members of (one of which shall be guide) the department appointed by the HoD.
- The candidates shall give a presentation on the seminar topic followed byquestion/answer and shall be assessed on the basis ofpresentation/communication skill, depth of understanding, selection of seminar topic, literature survey, seminar report etc.
- The following format may be used for ICA.

Sr No	Title of seminar	PRN of Student	Name of Student	Topic selection	Punctuality/Log Book	Work Quality/Report	Presentation	Depth of understanding (Oral)	Total
				3	7	5	5	5	25
1									
2									

Name and Signature of Examiners

End Semester Examination (ESE)

- The End Semester Exam for this course shall be based on presentation followed by question/answer session and demonstration of seminar deliverables. It shall be evaluated by two examiners out of which one examiner shall be out of institute and other shall be guide. (If guide is absent at the time of examination, the other examiner shall be the committee member of ICA evaluation)
- The following format may be used for assessment.

Sr No	Title of seminar	PRN of Student	Name of Student	Topic selection	Punctuality/Log Book	Work Quality/Report	Presentation	Depth of understanding (Oral)	Total
				3	3	5	5	9	25
1									
2									

Name and Signature of Examiners

ET451 COMPUTER NETWORK AND COMMUNICATION

Teaching Scheme: 03L Total: 03 **Credits:** 04
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

The course is designed to impart an insight into analysis and understanding of computer networks through its layered architecture. It deals with a systematic approach of building the fundamental concepts of communicating entities like protocols and their issues for design of functional layers they work with.

DESIRABLE AWARENESS/SKILLS

Students taking-up this course must have learnt digital communication principles.

COURSE OBJECTIVES

Objective behind offering this course and imparting its knowledge to students is-

1. To impart enriched knowledge and ability of analyzing and understanding various computer network and their topologies
2. To create zeal of working with these structures as demanded in the widespread field of Communications and networking
3. To enhance passion for designing these structures with professional features
4. To develop efficacy of building and handling different types of data/computer networks

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. solve the problems related to higher and complex computer networks
2. suggest and implement better solutions to the field practices of computer networks
3. design and develop modules for various computer network applications in fields

RELEVANCE OF POs AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
b	Design and conduct experiments on computer network and processes	3
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints.	2
e	Resolve various networking and maintenance related issues	2

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Physical Layer: Review of communication mediums, baseband and broadband transmission, Introduction to computer network, institution of standardisation organisation open system interface (ISO/OSI) reference model, Transmission Control Protocol/ Internet Protocol TCP/IP reference model, network topologies, network types like Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN), Asynchronous Transfer Mode (ATM) reference model, ATM Switches.

Data Link Layer: Design issues, framing, error and flow control, data link protocols, unrestricted simplex protocol, stop and wait protocol, simplex protocol for a noisy channel, sliding window protocols, one bit sliding window, Go-Back n protocol, selective repeat, High-level Data Link Control (HDLC), multiple access protocols, Areal Locations of Hazardous Atmospheres Computing Software & Applications Areal Locations Of Hazardous Atmospheres (ALOHA), Carrier Sense Multiple Access (CSMA), CSMA, Carrier Sense Multiple Access / Collision Detection (CSMA/CD), Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA).

Network Layer: Design issues of network layer, Comparison of Virtual circuit and Datagram subnets, routing algorithms, Shortest Path Routing (SPF), flooding, hierarchical routing, broad cast routing, multicast routing, congestion control algorithms, congestion prevention policies, choke packets, Internet Protocol (IP): Internetworking, Internet Protocol version 4 (IPV4) Datagram, Internet Protocol version 6 (IPV6) Addresses.

Network Layer and Transport Layer: Address Resolution Protocol **(**ARP), Reverse Address Resolution Protocol **(**RARP), Internet Control Message Protocol (ICMP), Internet Group Management Protocol (IGMP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), congestion control of transport layer, Quality of Service (QoS) and means of improving QoS.

Application Layer and security management: Domain Name System (DNS), Simple Network Management Protocol (SNMP), network security, cryptography, public key algorithms, digital signature, authentication protocols, firewalls, introduction to Voice over Internet Protocol (VOIP).

Text Books

1. Andrew S. Tanebaum - Computer Networks, 4th edition, PHI/ Pearson education.
2. William Stallings - Data and Computer communications, 10th edition, Pearson.

Reference Book

1. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, Addison Wesley, 5th Edition, March 2009, ISBN-13: 978-0136079675

ET455 COMPUTER NETWORK AND COMMUNICATION LAB

Teaching Scheme: 02P Total: 02 Credit: 01
Evaluation Scheme: 25 ICA + 25 ESE Total Marks: 50

Minimum twelve experiments shall be performed to cover entire curriculum of course ET455. The list given below is just a guideline.

1. Identification of various networks components - connections, BNC, RJ-45, I/O box - Cables, Co-axial, twisted pair, UTP - NIC (network interface card) - Switch, hub
2. Sketch wiring diagrams of network cabling considering a computer lab of 20 systems
3. Interfacing with the network card (Ethernet)
4. Preparing of network cables
5. Establishment of a LAN
6. Use of protocols in establishing LAN
7. Trouble shooting of networks
8. Installation of network device drivers
9. Installation of networks (Peer to Peer Networking client server interconnection)
10. Use/installation of proxy server
11. IP address assignment and troubleshooting
12. Network address conflict and resolution
13. Network management and security (A case study)
14. Data center (A case study)

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in oral examination.

ET452 MICROWAVE ENGINEERING AND FIBER OPTICS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course is designed to study microwaves, fibre optics and application areas of microwave energy. this course will explore the basic concepts of microwave devices and fiber optics. Students will learn and understand fundamentals of microwave engineering and fiber optics. they will learn concepts of negative resistance, s-parameters, reflection and transmission coefficient , propagation of microwave signal through a waveguide, propagation of signal through fiber optic cable, etc. in this course, more emphasis is given on understanding basics, visualizing the system as well as to study behaviour of signal through waveguides and fiber optic cables.

DESIRABLE AWARENESS/ SKILLS

Knowledge of basic mathematics, vector algebra, visualization skills, and an aptitude to understand principles of microwave engineering and fiber optics

COURSE OBJECTIVES

The objectives of offering this course are

1. to make students familiar to microwave communication as well as fiber optic communication.
2. to strengthen ability of students to visualize a system in three dimensions and develop a problem solving attitude.
3. to make students familiar with concepts and applications of microwave engineering and fiber optics.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. demonstrate the knowledge of the basics of microwave communication and fiber optics.
2. visualize along three axes.
3. acquire the skill of understanding hidden messages in any mathematical equation.
4. demonstrate the skill to understand physical significance of mathematical equation.
5. exhibit problem solving attitude.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
a	apply knowledge of basic sciences, mathematics and basic engineering courses as appropriate to the field of electronics and telecommunication engineering.	3
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	2

1-Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Introduction to Microwaves and Microwave Transmission Lines: Microwave frequencies and band designations, microwave devices, microwave systems, transmission – line equations and solutions, reflection coefficient and transmission coefficient, standing wave and standing wave ratio, smith chart.

Microwave Waveguides and Microwave Components: Rectangular waveguides, solutions of wave equations in rectangular coordinates, Transverse-Electric (TE) modes in rectangular and circular waveguides, Transverse Magnetic ™ modes in rectangular and circular waveguides, Transverse Electric and Magnetic (TEM) modes in rectangular and circular waveguides,microwave hybrid circuits, directional couplers, circulators and isolators, klystron tube, reflex klystron, solid state microwave devices: varactor diodes, PIN diode, gunn diode, microwave tunnel diodes, scattering parameters.

Microwave Measurements: Description of microwave bench – different blocks and their features, precautions, microwave power measurement – bolometer method, measurement of attenuation, frequency, Voltage Standing Wave Ratio (VSWR), impedance measurements.

Optical Fibers Structures, Wave Structures, Wave Guiding and Fabrication: Optical spectral bands, Basic optical laws and definitions, optical fibers modes and configurations, single mode fibers, graded index fiber structure, photonic crystal fiber, fiber materials and fabrication. signal degradation in optical fiber: attenuation, dispersion.

Optical Sources and Detectors: Direct and indirect band gap materials, Light Emitting Diodes (LEDs), LED structures, laser diodes, laser diode rate equations, structures and radiation patterns, single mode laser, properties of photo diodes, photo detector noises, fundamentals of receiver operation, digital receiver performance.

Digital Link: Point to point links, system consideration, power budget, rise time budget.

Text Books

1. Optical Fiber Communication, Gerd Keiser TMH, 4th Edition.
2. Microwave Devices and Circuits, Samuel Liao, Prentice Hall of India Private Limited, New Delhi, 3rd edition.
3. Microwave and Radar Engineering, M. Kulkarni, Umesh Publications, 3rd edition, 2003.

Reference Books

1. Optical Fiber Communications, John M. Senior, EEE, 2nd Edition.
2. Microwave Engineering, David M. Pozar, Wiley, 3rd Edition.

ET456 MICROWAVE ENGINEERING AND FIBER OPTICS LAB

TeachingScheme: 02P, Total: 02 **Credit:** 01
Evaluation Scheme: 25ICA +25 ESE **Total Marks:** 50

At least 10 experiments from the experiments stated below

1. To study microwave components.
2. To record various readings for modes of Klystron Tube.
3. To study and plot V-I characteristics of Gunn diode.
4. To study multihole Directional coupler and measure directivity.
5. To study characteristics of E-plane Tee and measure output at the two ports.
6. To study characteristics of H-plane Tee and measure output at the two ports.
7. To study characteristics of Magic Tee and measure output at the two ports.
8. To plot radiation pattern of Horn antenna.
9. To measure scattering parameters for E Plane Tee, and Magic Tee
10. To study fibre optic communication system.
11. To study LASER diode.
12. To study properties of Photodiode.
13. To study performance of a digital receiver.
14. To study photodetector diode.

ET453A NEURAL NETWORK AND FUZZY LOGIC

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course introduces the role of artificial intelligence in computer. This course gives introduction to the artificial neural network and fuzzy logic which is basic requirement for intelligent system. It provides the knowledge of neural network and fuzzy logic applicationsand demonstrates how these concepts can be applied to solve nontrivial real life problems.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic mathematics and set theory is required.

COURSE OBJECTIVES

The objectives of offering this course are to

1. learn the basic concepts of artificial neural network.
2. learn the various training and testing algorithms.
3. learn the classical and fuzzy set theory.
4. study various applications of neural algorithms and fuzzy logic systems.

COURSE OUTCOMES

On successful completion of this course student should be able to

1. demonstrate the knowledge of the neural network, classical and fuzzy set theory.
2. provide solutions for neural network and fuzzy logic problems, algorithms, implementation.
3. design intelligent agents for problem solving, reasoning, planning, and decision making.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
k	manage the project under execution effectively and professionally usingthe techniques, skills, and modern engineering toolsnecessary for engineering practice.	2
l	assist in research and development activities.	3

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Artificial Neural Network (ANN): Fundamental concept: ANN, biological neural network, brain vs computer, evolution of neural networks, basic models of ANN: types based on connections, learning and activation functions, terminologies of ANN, mcculloch-pitts neuron**:** theory and architecture. Linear seperability, Hebb network: theory, training algorithm, numerical.

Supervised Learning Networks: Introduction, perceptron networks: theory, architecture, perceptron learning rule, flow chart fortraining algorithm, training algorithms for single output classes and multiple output classes, perceptron network testing algorithm. Adaptive linear neuron (Adaline): theory, architecture, delta rule for single output unit,flowchart for training process, training algorithm, testing algorithm. Multiple adaptive linear neurons (medaline): theory, architecture, flowchart for training process, training algorithm, testing algorithm. Back propagation network: theory, architecture, flowchart for training process, training algorithm, learning factors, testing algorithm. Hetero associative memory network: theory, architecture, flowchart for training process, training algorithm, testing algorithm. Bidirectional associative memory (bam): theory, architecture.

Un-supervised Learning Networks Introduction: fixed weight competitive nets, Kohonen self-organizing feature maps, learning vector quantization, counterpropagating networks, adaptive resonance theory network.

Introduction to Fuzzy Logic: Motivation, fuzzy systems, fuzzy control from an industrial perspective,uncertainty and imprecision, uncertainty in information, vagueness,chance versus ambiguity, fuzzy set theory versusprobability theory, themathematics of fuzzy control. Classical sets and fuzzy sets: operations and properties of classical sets and fuzzy sets.

Classical Relations and Fuzzy Relations: Cartesian product, crisp relations, relations, cardinality, operations and properties of fuzzy relations, composition of fuzzy relations, tolerance and equivalence relations, value assignments, fuzzification, de-fuzzification.

Fuzzy Logic and Approximate Reasoning: Introduction, Linguistic variables, Fuzzy logic: Truth-values and truth tables in fuzzy logic, Fuzzy propositions. Approximate reasoning: Categorical, qualitative, syllogistic, dispositional reasoning, fuzzy If - then statements, Inference rules, the compositional rule of inference, representing a set of rule, Properties of a set of rule.

Adaptive fuzzy control & Neuro-fuzzy and Fuzzy-neural Control Systems: Introduction, Design and performance evaluation, the main approaches to design self-organizing controller, Model based controllers. Neuro-fuzzy and Fuzzy-neural Control Systems: Adaptive fuzzy systems, optimizing the membership functions and the rule base of fuzzy logic controllers using neural networks, fuzzy transfer functions in neural networks, case studies.

Text Books

1. Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa, Wiley India, Edition
2. Fuzzy Logic with Engineering Applications, Timuthi J. Ross,Wiley Publication, 2nd edition, 2004.
3. Introduction to Artificial Neural Systems, Jacek M. Zurada, West Publishing Company.

Reference Books

1. An Introduction to Fuzzy Control, D. Drainkov, H. Hellendoorn and M. Reinfrank, 2nd edition, Narosa Publishing House, 2010.
2. Fuzzy set theory and its applications, H. J. Zimmermann, 2nd edition, Allied Publishers limited, New Delhi, 1996.
3. Fuzzy systems theory and its application, T. Terano, K. Asai and M. Sugeno, Academic Press,1992
4. Fuzzy Sets and Fuzzy Logic: Theory and Applications, G. J. Klir and B. Yuan, Prentice Hall of India, New Delhi, 2002.
5. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis And Applications, S. Rajasekaran, G. A. Vijayalakshmi Pai, Eastern Economy Edition, New Delhi: Prentice-Hall of India, 2003.

ET453B MULTIMEDIA COMMUNICATION

Teaching Scheme: 03L Total: 03 **Credits:** 04
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

The course is designed to learn and implement multimedia communication technologies, tools therein and their applications across the field. It deals with a systematic approach of building the fundamental concepts of all involved communicating entities like devices, technologies, protocols and their issues for design of overall functionality.

DESIRABLE AWARENESS/SKILLS

Students taking-up this course must have learnt digital devices and communication principles.

COURSE OBJECTIVES

Objective behind offering this course and imparting its knowledge to students is-

1. To impart enriched knowledge and ability of analyzing and understanding various multimedia devices technologies and their functioning
2. To create zeal of working with these technologies in the widespread field of communications, networking and consumer electronics.
3. To enhance passion for designing these technologies with professional features

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. demonstrate the confidence of handling ultra-modern multimedia technologies.
2. suggest and implement better solutions to the field practices
3. design and develop modules for various state-of-art applications across the field

RELEVANCE OF POsAND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
b	Design and conduct experiments in multimedia communications	3
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints.	2
e	Resolve various multimedia communication technology related issues	2

1-Weakly correlated 2 - Moderately correlated 3 - Strongly correlated

COURSE CONTENTS

Multimedia communications: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, network and application Quality of Services (QoS).

Multimedia Information Representation: Introduction, digital principles, text, images, audio and video formats and types, latest multimedia format.

Text and Image: Introduction, compression principles, text compression, unformatted text, formatted text, hypertext, image compression, graphics, digitized pictures. Types of multimedia content: text, image, audio and video.

- Properties and usage of various types of document files (rtf, txt, doc, pdf)
- Properties and usage of various types of audio files (wav, aac, ac-3, mp3, wma, ram)
- Properties and usage of various types of image files (bmp, jpeg, tiff, eps, png, gif, dicom)
- Properties and usage of various types of video files (mp4, wmv, rm, avi, flv, mkv, avchd)
- Basics of media content processing: format conversion, compression, denoising and enhancement

Audio and Video Compression: Introduction, audio compression principles, Differential pulse-code modulation (DPCM), Adaptive Differential Pulse Code Modulation (ADPCM), Association for Progressive Communications (APC), Linear Predictive Coding (LPC), video compression and its principles, H.261, H.263, Moving Picture Experts Group (MPEG), MPEG-1, MPEG-2, MPEG-4

Text Book

1. Fred Halsall, Multimedia communications: Applications, Networks, Protocols and Standards Pearson education, Asia, second Indian reprint 2002.
2. William Stallings - Data and Computer communications, 10th edition, Pearson.

Reference Books

1. Ralf Steinmetz, Kiara Narstedt: Multimedia Fundamentals Vol-1, Media Coding and Content Processing, Pearson education, 2004.

ET453C TELECOMMUNICATION SWITCHING NETWORK AND MANAGEMENT

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course covers the various aspects of digital switching, transmission, multiplexing, signalling and management issues. The student will learn different switching systems in development and use of telecommunication system.The student will understand the analysis of telecommunication traffic.This course also make students familiar to telecommunication network management.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic electronics engineering and communication engineering

COURSE OBJECTIVES

The objectives of offering this course are

1. to introduce fundamental functions of a telephony.
2. to make students familiar with telecommunication traffic analysis and network management.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze telecommunication traffic and aware of network management.
2. evaluate the different signaling techniques in telecommunication network.
3. demonstrate the knowledge of the different switching, multiplexing and digital hierarchy namely SONET (Synchronous Optical Networking) /SDH (Synchronous Digital Hierarchy).

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints.	2
e	Solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	3

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Digital Switching: Switching functions, space division switching, time division switching, two-dimensional switching, S-T-S (Space Tme Space) switching, T-S-T (Time Space Time) switching, digital cross connect systems, consolidation and segregation, DCS (Distributed Control System) hierarchy, integrated cross connect equipment.

Digital Transmission and Multiplexing: Pulse transmission, inter symbol interference, timing inaccuracies, insufficient bandwidth, amplitude and phase distortion, asynchronous verses synchronous transmission, error performance, time division multiplexing , Synchronous Optical Network (SONET)/ Synchronous Digital Hierarchy (SDH), multiplexing overview, SONET)frame format, SONET Operations, administration and maintenance, payload framing and frequency justification, virtual tributaries, DS3 payload mapping, E4 payload mapping, SONET optical Standards, SONET Rings, unidirectional path switched ring, bidirectional line switched ring.

Switching and Telephony: Switching in the telephone network, evolution of switching systems, message switching, circuit switching, basic switching functions, electronic switching, digital switching systems, electronic space division switching.

Signaling: Common Channel Signaling Principles, Consultative Committee for International Telephony (CCITT) and Telegraphy signaling system no. 7, SS NO. 7 architecture and relationship to Open System Interconnection(OSI), signaling system structure, signaling data link (layer 1), the signaling link (level 2), signaling network functions and messages (layer 3), signaling network structure, signaling performance message transfer part, signaling connection control part, user part.

Traffic Analysis: Introduction, the unit of traffic, congestion, traffic measurement, traffic characterization, loss systems, network blocking probabilities, delay systems.

Network Management: Traditional breakout by tasks: fault management, configuration management, performance management, security management, accounting management, aids in network management provisioning, communications channels for the network management system, network management from a Public Switched Telephone Network (PSTN) perspective, introduction to network management protocols, telecommunication management network.

Text Books

1. Telecommunication Switching System and Networks, Thiagarajan Viswanathan, Eastern Economy edition, June 2012.
2. Telecommunication Switching, Traffic and Networks,J. E. Flood, Pearson edition 2013.

Reference Books

1. Telecommunication System Engineering, Roger L. Freeman,Willy India Edition, 4th edition 2012.
2. Digital Telephony,John C. Bellamy,Willy Student Edition, 3rd edition 2013.

ET453D NANOTECHNOLOGY

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course introduces the student to study basic of nanoelectronics and nanomaterials. The student will learn about nanotechnology nanostructures, fabrication and processing on nanomaterials. The ultimate aim is to study about nanostructures nanotubes, nanomaterials**,** nanophotonicin detail and to exercise the learner's knowledge and imagination of nanoscience and nanotechnology towards engineering application coupled with tools to characterize nanomaterials.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic science

COURSE OBJECTIVES

The objectives of offering this course are

1. to acquire basic understanding of advanced material, their functions and properties for technological applications.
2. to emphasize the significance of material selection in the design process.to encourage students in the development of nanomaterials.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze the properties and application of nanomaterials.
2. demonstrate the knowledge of nanotubes, nanomaterials,and nanomaterial processing.
3. evaluate the different tools to characterize nanomaterials.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints.	3
l	Assist in research and development activities.	2

1-Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Basic Nanotechnology: Approach and scope, definition and concepts, basic science: atoms, key subatomic particles, atomic structure, substance and elements, nomenclature and periodic table, making compounds, basic properties of silicon and basics of transistor and Metal Oxide Semiconductor (MOS) operation.

Nanoelectronics: Overview of basic nanoelectronic technologies: single electron device, quantum mechanical tunnel devices, spin nanoelectronics (spintronic), molecular nanoelectronics, fault tolerant designs, quantum cellular automata, quantum computing, additional details on nanoelectronics systems: quantum dots and quantum wires, quantum computing, steps for fabrication of MOS device and overview of technology, microscopy tools for nanoelectronics.

Properties and Application of Nanomaterial: Unique properties of nanomaterials: microstructure and defect in nanocrystalline material, effect of nano-dimensionson material behavior, synthesis routes: bottom-up approaches, top-down approaches, consolidation of nanopowders, application of nonmaterial's: nano-electronics, mems/nems, nanosensors, nanocatalysts, structure and engineering, automotive industry, nano-medical, textiles, paints, energy, defence and space.

Nanotubes, Nanomaterials and Nanomaterial Processing: Introduction, basic nanostuctures: carbon nanotube, nanowires, nanocones, application of carbon nanotube, nanowires, nanocones, quantum dots, quantum dots nanocrystals, ultrananocrystalline diamond, diamondoids, nanocomposites, thin-films, nanofoam, nanoclusters, smart nanostructures, environmental issues for nanomaterials, manufacturing techniques, system design.

Nanophotonic: Introduction and background: a plethora of opportunities, general photonics trends, basic nanophotonics, photonic crystals, photonic crystal fibers, photonic crystal lasers, photonic crystals : fabrication, telecom application of photonic crystal: quantum cascade lasers, photonic crystal, superprism effect in photonic crystal, nonlinear optics, confinement and microresonators, quantum optics, super lenses

Tools to Characterize Nanomaterials: X-Ray Diffraction(XRD), XPS, Small Angle X-ray Scattering (SAXS), Scanning Electronic Microscopic (SEM), Transmission Electronic Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Field Ion Microscope (FIM), Three-Dimensional Atom Probe(3DAP), nanoindentation.

Text Books

1. Fundamentals of Nanoelectronics, George W. Hanson, Pearson 2012.
2. Nanoscience and Nanotechnology: Fundamentals to Frontiers, M. S. Ramachandra Rao,Shubra Singh, Wiley Edition ,2013.

Reference Books

1. Nanotechnology Applications to Telecommunications and Networking, Daniel Minoli, Wiley Student Edition 2011.
2. Introduction to Nanotechnology, Charles P. Poole, Jr., Frank J. Owens, Wiley student Edition 2013.

ET454A ADVANCED DIGITAL SIGNAL PROCESSING

Teaching Scheme:03L+0T; Total: 03 **Credits**: 03
Examination Scheme: 10ISA+15ISE1+15ISE2+60ESE **Total Marks:** 100
Duration of ESE: 03 hrs

COURSE DESCRIPTION

This course digital signal processing make the students aware about discrete signals. The course explores on understanding discrete data systems and its analysis using Z-transform, Fourier transform, and sample data systems. Further Digital Signal Processing (DSP) processors like TMS are introduced.

DESIRABLE AWARENESS/SKILLS

Knowledge of digital electronics, control system and microprocessor

COURSE OBJECTIVES

The objectives of the course are to

1. know concepts of multi rate signal processing and adaptive filtering.
2. learn the parametric and non parametric methods of power spectrum estimation.
3. learn finite word length effects in Finite Impulse Response (FIR) / Infinite Impulse Response (IIR) filters and Fast Fourier Transform (FFT) algorithms.
4. specify and design any digital filters using matlab.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze concepts of Multi rate signal processing and adaptive filtering.
2. compare the parametric and non parametric methods of power spectrum estimation.
3. implement finite word length effects in FIR/IIR filters and FFT algorithms.
4. specify and design any digital filters using matlab.

RELEVANCE OF PROGRAM OUTCOMES(POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
b	Design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data.	2
c	Design a component , system or process to meet the specifications and requirements within pragmatic constraints.	3
d	Solve problems related to electronics engineering in interdisciplinary projects.	1
e	Assist in research and development activities.	1

1 - Weakly correlated **2 - Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Review of Fundamentals of Digital Signal Processing: Sampling of signals in time and frequency domain, analysis and design of discrete –time systems in frequency domain, review of FIR filter design methods: window, equiripple linear phase FIR, FIR differentiator, Hilbert transform, IIR filter design methods. Frequency transformations, Direct design methods: Pade, Least squares.

Multirate Digital Signal Processing: Introduction and concepts of multi rate signal processing, design of practical sampling rate converters, software implementation of sampling rate converters- decimators and interpolators, sampling rate conversion using poly phase filter structure, applications

Adaptive Digital Filters: Concepts of adaptive filtering, basic wiener filter theory, MMSE criteria, the basic LMS adaptive algorithm, Recursive Least Squares (RLS) algorithm, applications: adaptive filtering of ocular artefacts from the human EEG, adaptive telephone echo cancellation, radar signal processing, fetal monitoring, multipath compensation etc.

Power Spectrum Estimation: Estimation of spectra from finite – duration observation of signals, nonparametric methods for power spectrum estimation: Bartlett, Welch, Blackman and Tukey, performance characteristics of nonparametric power spectrum estimators, computational requirements of power spectrum estimates. Parametric methods for power spectrum estimation: relationship between autocorrelation and the model parameters, relationshipof AR process to linear prediction, Yule- Walker, Burg, Unconstrained Least Squares, sequential estimation methods for the AR model parameters, selection of a AR model order , MA model for power spectrum estimation, ARMA model for power spectrum estimation, Capon method, pisarenko harmonic decomposition method.

Quantization Effects in Digital Signal Processing (DSP): Binary fixed –point and floating – point representation of numbers, rounding and truncation errors, quantization effects in analog to digital conversion of signals, quantization of filter coefficients, quantization effects in digital filters, quantization effects in the computation of the DFT.

Text Books

1. DSP: Principles, Algorithms and Applicationby Proakis and Manolakis, PHI, 3rd edition,1996
2. Digital Signal Processing by E C Ifeacher and B W Jervis, Adison,Wesley 1993.
3. Digital Signal Processing by A. V. Oppenheim and R. W. Schafer,PHI.
4. Introduction to Digital Signal Processing by Johnny Johnson,PHI, 4th edition,1989.

Reference Books

1. M Digital Signal Processing by H. Hayes by Schaum's McGraw-Hill 1999.
2. Small DSP laboratory using MATLAB S. K.Mitra, McGraw-Hill, 1999.

ET457A ADVANCED DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme:02P; Total: 02 Hrs **Credits** : 01
Examination Scheme:25 ICA, 25 ESE **Total Marks :**50

The laboratory work should consist of experiments based on theory syllabus of ET454. Experiments should involve simulation/performance/design/demonstration of practical, result and conclusion based on it. The sample list given below is just a guide line.

1. C program/MatLab program Low Pass FIR filter using Hamm/Kaiser/Triangular/etc. windows
2. C program/ MatLab program Low Pass IIR filter by Impulse Invariance method using Butterworth approximation
3. C program/ MatLab program Low Pass IIR filter by bilinear transformation using Chebyshev approximation
4. C program/ MatLab program Band Pass IIR filter by bilinear transformation
5. C program/ MatLab program for multi rate processing and system design
6. C program/ MatLab program for demonstration of decimators
7. C program/ MatLab program for demonstration of Interpolators
8. Demonstration of multi rate signal processing applications
9. C program/ MatLab program for adaptive filtering
10. C program/ MatLab program for demonstration LMS algorithm
11. C program/ MatLab program for demonstration RLSS algorithm
12. C program/ MatLab program for demonstration of application: adaptive filtering of ocular artefacts from the human EEG.
13. C program/ MatLab program for demonstration of application:adaptive telephone echo cancellation,
14. C program/ MatLab program for demonstration of application radar signal processing,
15. C program/ MatLab program for demonstration of application fatal monitoring, multipath compensation etc.
16. Study of Finite word length effects in FIR/ IIR filters
17. Study of Finite word length effects in FFT algorithms
18. TMS 320CXX/ADSP 2105 based experiments based on any of the above list.

Note

- **Guide lines for ICA** Internal Continuous Assessment shall support for regular performance of minimum 10 practicals and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by student. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

- **Guide lines for ESE** The End Semester Examination (ESE) for this laboratory course shall be based on oral examination based on the curricula of theory course and experiments/ demonstrations performed in the semester to judge the depth of understanding/knowledge or analytical capability and software skills acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be subject teacher/ course coordinator and another examiner shall be the one appointed by Head/ Chairman BoS.

ET454B RADIATION AND ANTENNA DESIGN

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

This course is designed to study radiation phenomenon in detail. This course will explore the basic concepts of radiation and antenna design. students will learn and understand fundamentals of radiation and procedure to design antenna. They will learn concepts of antenna design based on the radiation. In this course, more emphasis is given on understanding basics, visualizing the system as well as to design antenna efficiently.

DESIRABLE AWARENESS/SKILLS

Knowledge of differential equations, antenna fundamentals, radiation pattern of antenna and an aptitude to understand principles of radiation and antenna design.

COURSE OBJECTIVES

The objectives of offering this course are

1. to make students familiar to different types of antennas.
2. to strengthen ability of students to visualize a system in three dimensions and develop a problem solving attitude.
3. to make students familiar with concepts and applications of antenna design.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. analyze the basics of radiation.
2. apply and implement the basic design conceptsof antenna.
3. evaluate the problems faced during design of antenna.
4. demonstrate the problem solving attitude related to antannas.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
c	Design a component, system or process to meet the specifications and requirements within pragmatic constraints.	2
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	2

1-Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Introduction: Types of antenna, dipole antennas and directional properties, travelling wave antennas, other types of antennas, radiation mechanism, antenna parameters: gain, antenna terminal impedance, etc. practical antennas and methods of excitation.

Radiation: Potential functions and the electromagnetic field, potential functions for sinusoidal oscillations, the alternating current element, power radiated by a current element, application to short antennas, current distribution, radiation from a quarter –wave monopole or half wave dipole, electromagnetic field close to an antenna, far-field approximation.

Antenna Fundamentals: Antenna terminology: radiation pattern, radiation power density, radiation intensity, directivity, gain ,antenna efficiency, half power beam width, bandwidth ,antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity, antenna temperature and signal-to noise ratio. radiation integrals: vector potentials A, J, F, M, electric and magnetic fields, electric and magnetic current sources, wave equation, far field radiation.

Dipole Antennas: Directional properties of dipole antennas, travelling wave antennas, antenna gain, antenna terminal impedance, loop antennas, practical antennas.

Antenna Arrays: Mathematics of linear arrays, antenna synthesis, the tchebysheff distribution, two element array,linear arrays, uniform amplitude and spacing, broad side and end-fire array, N- element array.

Principles of Broadband Antenna Design: Introduction to broadband antennas, antenna bandwidth, frequency independent antennas, log periodic antennas, array theory for LP and FI structures, other types of log periodic antennas, design of parabolic reflector antennas (dish antennas)

Text Books

1. Electromagnetic Waves and Radiation Systems, E.C.Jordon and K.G.balmain ,Prentice Hall of India, 2nd edition.
2. Antenna Theory-Analysis and Design, C.A.Balanis, John Wiley

Reference Books

1. Antenna and Wave Propagation,K.D.Prasad, Satya Prakashan, New Delhi
2. Antennas, J.D.Kraus, Mc Graw Hill.

ET457B RADIATION AND ANTENNA DESIGN LAB

Teaching Scheme: 02P, Total: 02 **Credit:01**
Evaluation Scheme: 25ICA +25 ESE **Total Marks: 50**

A. To measure radiation pattern, return loss, impedance, gain, beam width for the following antennas (Any Five)

1. Dipole antenna,
2. Folded dipole,
3. Yagi-Uda,
4. Horn,
5. Parabolic reflector,
6. Microstrip antennas.

B. Simulation of following antenna arrays (plotting radiation pattern) using matlab or any other open

1. Broadside linear array,
2. End fire linear array,
3. Two element array, linear array,
4. N element array,
5. Frequency independent antenna,
6. Log periodic antennas.

ET454C COMPLEMENTARY METAL OXIDE SEMICONDUCTOR (CMOS) AND VERY LARGE SCALE INTEGRATION (VLSI) DESIGN

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION

This course will direct design and analysis of analog circuits, precisely, design concepts relevant to real world applications, with a prominence on CMOS. It deals with the design and analysis of CMOS single stage and differential amplifiers at low and high frequencies of operation. This course introduces the design of current mirror and CMOS op-amp circuits. It also describes the noise analysis of CMOS amplifiers. Circuit performance is predicted by intuition and simple hand calculations, and is verified by computer simulations. The course also involves design projects which will be assigned using design software.

DESIRABLE AWARENESS/SKILLS

A background in CMOS operation and operational amplifiers circuit analysis

COURSE OBJECTIVES

The objectives of offering this course are

1. to create models of moderately sized CMOS circuits that realize specified digital functions to design and analyse the single stage and differential MOS amplifiers
2. to analyse the MOS OP-AMP circuits and to study the frequency response of MOS amplifiers
3. to understand the noise analysis of MOS amplifiers

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. design CMOS analog circuits suitable for low and high frequency applications
2. analyze the small, large-signals and noise of MOS circuits.
3. design basic CMOS circuits based on the knowledge acquired in the course.
4. demonstrate the software skills for the analysis and design of circuits.

RELEVANCE OF PROGRAM OUTCOMES (POS) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
a	apply knowledge of basic sciences, mathematics and basic engineering courses as appropriate to the field of electronics and telecommunication engineering	2
b	design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data	1
c	design a component, system or process to meet the specifications and requirements within pragmatic constraints	3
d	solve problems related to electronics engineering in interdisciplinary projects	3

1-Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Introduction to Analog Design: Metal Oxide Semiconductor Field Effect Transistor **(**MOSFET) as analog device, MOS device models, MOSFET structure and switch, MOS characteristics, single stage amplifiers, common source stage, source follower stage, common gate stage, cascode stage, folded cascode.

Differential and Operational Amplifiers: Single ended differential operation, Basic differential pair, qualitative and quantitative analysis, common mode response, differential pair with MOS loads, Gilbert cell, one stage and two stage op amps, gain boosting, common mode feedback, input range limitation, slew rate, power supply rejection, noise in op-amp

Passive and Active Current Mirrors: Basic and cascode current mirrors, active current mirrors, large and small signal analysis, common mode properties

Frequency Response of Amplifiers: Miller effect, association of poles with nodes, stages: common source, source followers, common gate, cascode, differential pair.

Noise and Feedback: Noise characteristics and types, representation of noise in circuits, noise in single stage amplifiers: common source, common gate, source followers, cascode stage, noise in differential pairs, noise bandwidth, feedback general considerations, feedback topologies, effect of loading, effect of feedback on noise

Stability and Frequency Compensation: Multi pole system, phase margin, frequency compensation, compensation of two stage op-amps, other compensation techniques

Band Gap References and Phase locked loops: Supply independent biasing, temperature independent references, PTAT current generation, speed and noise issues, simple PLL, charge pump PLLS, non-ideal effects in PLL, delay locked loops, applications

Text Books

1. Design of Analog CMOS integrated circuits, Behzad Razavi, Tata McGraw Hill Edition, 2002
2. Design with Operational Amplifiers and Analog Integrated Circuits, Tata McGraw Hill Edition, 2002

Reference Books

1. CMOS Analog Circuit Design, Philip E Allen, Douglas R. Holberg, Oxford, 2002
2. Analog Integrated Circuit Design, David A Johns, Ken Martin, Wiley Students edition, 2002
3. CMOS VLSI Design, Weste and Harris, Addison Wesley, Pearson Education edition, 2006
4. Fundamentals of Microelectronics, Behzad Razavi, Tata McGraw Hill Edition, 2002

ET457C CMOS VLSI DESIGN LAB

Teaching Scheme: 02P **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

Minimum 08 experiments from list shall be performed to cover entire curriculum of course ET457C. Perform experiments using Oscad/ NGSPICE/ HSPICE/ Micro Cap software. The list given below is just a guideline.

LAB COURSE CONTENT

1. Design a MOS common source amplifier with resistive load. Also draw schematic and perform transient, DC, AC analysis.
2. Design a CMOS common source amplifier with current source load/diode connected load in schematic and simulate for transient characteristics.
3. Design a MOS common drain amplifier (source follower amplifier). Also perform transient, DC and AC analysis.
4. Design two stage operational amplifiers. Also perform transient, DC and AC analysis
5. Design a differential amplifier using CMOS Current Mirror in schematic and simulate for Transient Characteristics.
6. Design a CMOS cascaded current mirror in schematic and simulate for Transient Characteristics.
7. Design a CMOS Common Gate Amplifier in schematic and simulate for transient characteristics.
8. To determine noise in CMOS differential pair.
9. To study designing of CMOS inverter layout.
10. To study negative feedback topologies.

ET454D INDUSTRIAL AUTOMATION AND CONTROL

Teaching Scheme: 03L+00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 15 ISE1 + 15 ISE2 + 10 ISA + 60 ESE **Total Marks:**100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

The course focuses on automatic process control systems and controllers, Programmable Logic Controller (PLC) and industrial protocol. The course will cover Supervisory Control System (SCADA), PLC system in terms of their architecture their interface to the process hardware, the functionality and the application development of the controls of machinery.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic electrical engineering, electric and magnetic circuit concepts, electric machines fundamentals, control systems.

COURSE OBJECTIVES

The objectives of offering this course are

1. to understand the role of industrial automation for different processes.
2. to learn the application of PLC and SCADA based system in process control.
3. to understand the basics of industrial communication protocol.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. apply the knowledge of automation in machine control.
2. design and demonstrate realistic constraints on motors such that it is applicable in manufacturing, testing and maintenance field.
3. design the automation system for fast and value added quality product for economical growth through technological development.
4. solve engineering solution for fast growing industrial sector with reliable atomized system using PLC and SCADA system.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	Pos	Level of co-relation
b	Design and conduct experiments on electronics industrial set up (PLC, and supervisory control systems) as well as analyze and interpret the resulting data for control of manufacturing and processing systems.	3
c	Design a component, system or process to meet the specification and requirements within pragmatic constraints using modern engineering tools, software and equipments.	2
d	Solve problem related to electronics engineering in interdisciplinary projects.	2
e	Solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	2

1 - Weakly correlated **2 - Moderately correlated** **3 - Strongly correlated**

COURSE CONTENT

Automatic Process Control Systems and Controllers: Introduction, history of process control systems, examples of process control systems, block diagram representation of process control systems, types of process control systems, classification of application based control systems, automatic controllers, classification of controllers, control objectives, benefits of process control systems. Control Modes: on/off action, differential action, proportional action, derivative action, integral action, Proportional Integral Derivative (PID) action. Implementation of control loops: on/off action pneumatic controller, on/off action electrical controller, PID action pneumatic controller, PID action control circuits, PID electronic controller. Sensors and Transducer: Introduction, performance terminologies: range and span, error, accuracy, sensitivity, selection of sensors.

Computer-aided Measurement and Control Systems: Introduction role of computers in measurement and control, elements of computer-aided measurement and control, computer-aided process control architecture, man-machine interface, computer-aided process control hardware, process-related interfaces, communication and networking, industrial commendation systems, data transfer techniques, computer-aided process control software, Real-Time Operating System (RTOS), real-time application software for process control, software fault tolerance, computer based Data Acquisition (DAQ) system.

Programmable Logic Controllers and SCADA systems: Introduction, basic PLC structure, I/O processing, Ladder programming, Function Block Diagram (FBD) programming, instruction lists, latching and internal relays, sequencing, timers and counters, shift registers, master and jump controls, data handling, Introduction, overview of SCADA, introduction to Distributed Control System (DCS).

Signal Transmission, Industrial Protocol and communication: Introduction, pneumatic transmission, analog transmission, digital transmission, controller, analog to digital and digital to analog conversion techniques, Introduction to HART protocol, field bus, architecture, advantages and limitations, profibus, foundation fieldbus versus profibus.

Selection, Installation and Commissioning of Instruments: Introduction, selection of instruments, reliability of measurement system, total lifetime operating cost of measurement system, installation and commissioning of instruments: storage and protection, mounting and accessibility, piping system, air supplies, pneumatic signals, impulse lines, cabling, earthing, testing and pre-commissioning, plant commissioning.

Text Books

1. Industrial Instrumentation and Control, S. K. Singh, 2nd edition, TMH, 2008.
2. Fundamentals of industrial instrumentation and process control, William C. Dunn, TMH, 2012.
3. Mechatronics, A multidisciplinary approach, William Bolton, 4th edition (12th reprint), Pearson Education Limited.

Reference Books

1. Process Software and Digital Networks, Instruments Engineers Handbook, Bela G. Liptak, 3rd edition, CRC Press.
2. Application of Computer in Process Control, Considine, TMH, 5th edition, 2009.
3. Modern Control Techniques for the process industries, T. H. Tsai, J.W Lane, MareetDekkar, 1st edition, N.Y 1986
4. Distributed Computer Control for Industrial Automation, Vijay P. Bhatkar, DobrivojePopovic, 2nd edition, Dekker, CRC Press 1990.
5. Computer-based Industrial Controls, Krishan Kant, 2nd edition, PHI 2004.

ET 457D INDUSTRIAL AUTOMATION AND CONTROL LAB

Teaching Scheme: 02P; Total: 02 **Credit:** 01

Evaluation Scheme:25 ICA + 25 ESE **Total Marks:**50

COURSE DESCRIPTION

In this laboratory course emphasis, will be on design and development of control logic using PLC and SCADA. Minimum ten experiments shall be performed to cover entire curriculum of course ET454D.The list given below is just a guideline.

List of Experiment

1. Develop ladder logic for AND, OR, NAND gates.
2. Develop ladder logic for ON-OFFofmotor.
3. Develop ladder programming for ON-delay and OFF-delay timer.
4. Develop ladder programming for tank water level controller with top and bottom sensor.
5. Develop ladder logic program for interfacing of induction motor control using DOL starter.
6. Develop ladder logic program for interfacing of induction motor control using star – delta starter.
7. Develop ladder logic program for interfacing of proximity switch.
8. Develop one application on SCADA.
9. Develop ladder logic program for interfacing liquid level sensor to PLC.
10. Develop ladder logic program for interfacing bottle filling plant to PLC.
11. Develop ladder logic program for interfacing temperature sensor to PLC.
12. Pump1 is driven by Motor 1 and Pump 2 is driven by Motor 2. Push button P1 (NO Type) operates Pump 1 in momentary fashion and Pump 2 in confirmed fashion. Push Button P2 (NC Type) stops the Pump 2. Prepare IO List of PLC and draw Ladder Diagram.

Note

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and recordsubmitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based onperformance in one of the experiments performed by student in the semester followed bysample questions to judge the depth of understanding/knowledge or skill acquired by thestudent. It shall be evaluated by two examiners out of which one examiner shall be out ofinstitute.

ET 458 PROJECT PHASE-II

Teaching Scheme:04P; Total: 04 **Credits:** 04
Evaluation Scheme: 50ICA+ 100ESE **Total Marks:** 150

COURSE DESCRIPTION

The course Project Phase-II is the extension of the work completed in the course Project Phase-II. It is expected to exert on design, development and testing of the proposed work as per the schedule.

COURSE CONTENT

- The remaining work of Project Phase – I shall be undertaken and completed by the same group of students in this course as the project is a yearlong activity.
- **Project Phase - II deliverables:** A project report as per the specified format (available on the institute website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of continuous progress (Log Book) duly signed by guide and present as Project Phase - II deliverable along with report.

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. demonstrate ability to synthesize knowledge and skills previously gained.
2. suggest, design and implement the technical work using suitable methodology.
3. prepare and present technical report in appropriate format.
4. exhibit leadership attitude and team spirit.

EVALUATION SYSTEM

It includesInternal Continuous Assessment (ICA) and End Semester Examination (ESE).
Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by departmental committee consisting of two - three faculty members of the department (one of which shall be guide) appointed by the HoD following the principle of continuous evaluation i.e. project reviews as per academic calendar.
- Examiners shall judge the student on the basis of presentation, deliverables of Project Phase – II described earlier. In case of unsatisfactory performance, committee may recommend repeating the Project Phase – II work and such group shall reregister for this course in next semester.
- The following format may be used for ICA i.e. it shall be used for all reviews and end semester evaluation. Average marks of all reviews and end semester evaluation shall be the final marks of ICA.

Sr No	Title of Project	PRN of Student	Name of Student	Report and Log Book	Work Completed and Its quality	Punctuality of individual (Guide's evaluation)	Presentation	Depth of understanding (Oral)	Total
				10	5	10	10	15	50
1									
2									

Name and Sign of Examiners

End Semester Examination (ESE)

- The End Semester Exam for this course shall be based on presentation and demonstration of Project Phase – II deliverables followed by oral examination. It shall be evaluated by two examiners out of which one examiner shall be out of institute and other shall be guide. (If guide is absent at the time of examination, the other examiner shall be the committee member of ICA evaluation)
- The following format may be used for assessment.

Sr No	Title of Project	PRN of Student	Name of Student	Topic selection	Report and Log Book	Work Quality	Presentation	Depth of understanding (Oral)	Total
				10	20	20	20	30	100
1									
2									
Name and Sign of Examiners									

ET 459 INDUSTREIAL LECTURE

Teaching Scheme: 01 L; Total: 01 **Credit: 0**1
Evaluation Scheme: 25 ICA **Total Marks:** 25

COURSE DESCRIPTION

This course is designed in continuation with the course ET 362 INDUSTREIAL LECTURE-I which is taught in sixth semester. It reflects on the importance of acquaintanceships and the interchange of needed information between practicing engineers in industry and students in educational institutions. There is a criticism, especially from practicing engineers, that existing engineering education is too theoretical and numerical with less orientation toward practical aspects. This course is designed to overcome this criticism. This course is intended to generate such interaction directly, through expert lectures by outstanding practicing engineers. This course will prove helpful to denote and understand the relations among the employers, employees, and other organisations.

DESIRABLE AWARENESS/SKILLS

1. Listening, understanding and analysing ability along with the knowledge of concepts, principles and techniques studied earlier.
2. Should have successfully completed the course ET 362 INDUSTREIAL LECTURE-I.

COURSE OBJECTIVES

The objectives of offering this course are

1. to make students familiar with industrial environment i.e. to provide appropriate exposure to world of work.
2. to know and understand the industrial experience, attitudes, needs, and viewpoints of industrial expert to students.
3. to denote and understand the role of various parties' viz., employers, employees, and state in maintaining industrial relations.
4. to improve industry institute interaction.

COURSE OUTCOME

On successful completion of this course students shall be able to

1. demonstrate the ability to face industrial environment/ world of work.
2. fulfill expectations of industry wrt expertise, attitude and viewpoint.
3. demonstrate the good inter personnel relations.
4. work in industrial environment either as employee or self-employed (entrepreneur) with comfort.

RELEVANCE OF PROGRAM OUTCOMES (POs) AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
e	solve industrial problems related to electronics, communication engineering, networking and maintenance of engineering systems employing electronic sub-system.	2

h	understand and apply contextual knowledge to assess and solve social, health, safety, legal cultural and environmental issues related to engineering practices in general and electronics engineering practices in particular.	1
i	recognize the need for and have the ability to engage in, perpetual learning by working on projects for which they have no prior experience and by adapting latest advancement in technology and concepts.	2
j	interpret and update with contemporary issues affecting engineering industry.	2
k	manage the project under execution effectively and professionally using the techniques, skills, and modern engineering tools necessary for engineering practice.	3

1-Weakly correlated 2- Moderately correlated 3 - Strongly correlated

COURSE CONTENT

- There shall be minimum 6 lectures of 60 -90 minutes duration.
- The lecture shall include presentation, informal discussions with students and faculty, and laboratory tours (if required).
- Topics of Industrial Lectures shall be technical in nature and should not be the specific or extended part of the curriculum.
- Typically speakers should talk about:
  i. Their own career following (and sometimes including university).
  ii. Interesting jobs/projects they have had worked on.
  iii. The areas of work they are currently involved in.
  iv. The type of work engineering graduates can expect.
  v. Current job opportunities that may be available for engineering graduates in general and electronics and telecommunication engineering graduates in particular.
  vi. Any suggestions for students with regard to job hunting / CV writing / interviews etc.
  vii. Latest technology used in the industry which is not the part of curriculum or routine training programmes.
  viii. Any other suitable topic/information which provides industrial exposure and improves entrepreneurship quality/ employability of the students.
- Course coordinator shall discuss with students on the content of lecture and may conduct oral or give written assignments to judge the depth of understanding of students.
- Students shall submit the report based on minimum six lectures giving summary of the lecture delivered.
- The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in the format provided by institute/department.
- **Industrial Lecture deliverables:** An industrial lecture report as per the specified format (available on in the department and institutes website) and assignments given by course coordinator (if any).

(**Note:** List of renowned experts/Officials from Industries/Government Organizations/Private Sectors/Public Sectors / R&D Labs etc shall be prepared by the committee appointed by HoD and shall be approved by principal. After approval from the principal, minimum six Industrial

Lectures shall be arranged, which shall be delivered by experts to cover the various aspects of course content)

Evaluation system It includesInternal Continuous Assessment (ICA). Guidelines for ICA are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by course coordinator.
- Course coordinator shall judge the students on the principle of continuous evaluation and contribution of individual student.
- It shall be evaluated on the basis of deliverables of industrial lecture and depth of understanding (oral conducted by course coordinator).
- Course coordinator shall maintain the record of continuous evaluation (oral) and include in the record of sixth semester received from HoD.
- Total of sixth and eighth semester marks shall be converted out of 25 and entered in MIS by course coordinator.

ET460: INDUSTRIAL VISIT/ INDUSTRIAL TRAINING/SPECIAL STUDY/ ENTRPRENEURSHIP DEVELOPMENT PROGRAM

Teaching Scheme:00L+00T Total 00 **Credits:** 01
Examination Scheme: 25 ICA **Total Marks:** 25

COURSE DESCRIPTION

This multi option course explores the knowledge of industry organization, new trends in manufacturing, maintenance and safety or give actual work experience with exposure to industrial environment or boost entrepreneurial aspirations or analytical skills to solve real life problem as per student interest.

DESIRABLE AWARENESS/SKILLS

Clarity of goal setting about career path ahead after completion of under graduation.

COURSE OBJECTIVES

The objectives of the course are to

1. introduce the basic industries and the process/product development cycle.
2. be familiar with the industrial environment and work culture
3. learn the importance of entrepreneurial skills.
4. emphasizes intuitive understanding and practical implementations of the theoretical concepts

COURSE OUTCOMES

On successful completion of this course student shall be able to

1. demonstrate the knowledge of organizational set up of an industry.
2. evaluate and analyze the manufacturing, material handling, maintenance, safety standards and environmental considerations in industry.
3. explore entrepreneurial ways to understand the impact of engineering solutions in a global, economic, environmental and social context.
4. exhibit analytical skills to solve real life problem as per student interest.

RELEVANCE OF COs /POs AND STRENGTH OF CO-RELATION

PO No.	POs	Level of co-relation
b	design and conduct experiments on electronics industrial set up, as well as analyze and interpret the resulting data.	2
d	solve problems related to electronics engineering in interdisciplinary projects.	2
f	understand and adapt universal skills and culture without losing human and ethical values.	2
g	communicate (oral and written) effectively both individually and within multidisciplinary teams.	2
i	recognize the need for and have the ability to engage in, perpetual learning by working on projects for which they have no prior experience and by adapting latest advancement in technology and concepts	1

k	manage the project under execution effectively and professionally using the techniques, skills, and modern engineering tools necessary for engineering practice.	2
m	maintain quality, timeliness and continuous improvement.	1

1- Strongly correlated 2 - Moderately correlated 3 - Weakly correlated

COURSE CONTENT

This course shall be completed preferably during the summer vacation after sixth semester but in exceptional cases can be completed during the winter vacation after seventh semester or during the weekends of seventh semester. **Under any circumstances; this course shall be completed before the commencement of eighth semester.**

Industrial visit Industry visits for minimum four industries local or outstation shall be carried out by each student. Department shall arrange the industrial visits during the summer/winter vacations after sixth/seventh semester or in exceptional cases weekends during the seventh semester. Industries shall be related to solar energy/ power electronics/ telecom sector/ computer hardware-software/ manufacturing/ automobile automation/ bio-tech-agriculture sector/power station, Tv-radio station/ sugar-chemical factory/ any other relevant industry approved by course coordinator.

or

Industrial Training Individual or group of students shall undergo industrial training in any industry of own interest and convenience related to electronics and telecommunication for minimum one week fulltime or two weeks part time so that total training period should be more than 40 hours.

or

Entrepreneurship Development Program Individual or group of students shall undergo 3 – 5 days Entrepreneurship Development Program (EDP) organised by professional /government /public/ private sector organization. Department can organise such EDP training to facilitate the students. The students interested to start own enterprise/business can opt for EDP.

or

Special Study The students interested in higher studies in engineering/ management/ etc or to start own business can opt for special study. It shall include study of typical industrial/social/ domestic/organizational real life problem as approved by the course coordinator to formulate problem and suggest remedies/alternative approaches to solve the problem or students can undergo any market or any other suitable statistical survey and obtain some result from the survey.

Course Deliverable Every student shall submit the appropriate (visit/training/attendance/visit for special study) certificate along with a report in the format provided by department/course coordinator duly signed by course coordinator and HoD.

EVALUATION SYSTEM

It includesInternal Continuous Assessment (ICA) and Guidelines for ICA are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by course coordinator appointed by the HoD.
- Course coordinator shall judge the student on the basis of presentation, deliverables of the course described earlier.
- The following format may be used for ICA

Sr No	PRN of Student	Name of Student	Course undertaken	Report	Presentation and Depth of understanding	Total
				10	15	25

Name and Signature of Examiner