Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: ELECTRONICS & TELECOMMUNICATION ENGINEERING

Name of the Course: T.Y.B. Tech (Sem.– I & II)

(Syllabus to be implemented from w.e.f. June 2020)

PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF SCIENCE & TECHNOLOGY
Electronics & Telecommunication Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. To make students competent for professional career in Electronics & allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Electronics & other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conducting their professional work.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of t h e engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

1. Graduates will be able to attain a **solid foundation** in Electronics and Communication Engineering with an ability to function in multidisciplinary environment.
2. Graduates will be able to use **techniques and skills** to design, analyze, synthesize, and simulate Electronics and Communication Engineering components and systems.
3. Graduate will be capable of **developing programs** in Assembly, High level and HDL languages using contemporary tools for software development.

PUNYASHLOK AHILYADEVI HOLKAR

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Science & Technology

Credit System structure of T.Y. B.Tech. Electronics & Telecommunication Engineering ***W.E.F. 2020-21***

Semester I

Course Code	***Theory Course Name***	***Hrs./week***			***Credits***	***Examination Scheme***			
		L	***T***	***P***		***ISE***	***ESE***	***ICA***	***Total***
ET311	Electromagnetic Field Theory	3	1	--	4	30	70	25	125
ET312	Digital Design & HDL	4	--	--	4	30	70	25	125
ET313	Digital Signal Processing	4	--	--	4	30	70	25	125
ET314	Microcontrollers and Applications	4	--	--	4	30	70	25	125
ET315	Open Elective-I	3	1	--	4	30	70	25	125
SLH31	Self Learning Module-I	--	--	--	2	--	50	--	50
Sub Total		18	2	--	22	150	400	125	675
Course Code	***Laboratory Course Name***								
							ESE		
							POE	***OE***	
ET312	Digital Design & HDL	--	--	2	1	--	50	--	--	50
ET313	Digital Signal Processing	--	--	2	1	--	50	--	--	50
ET314	Microcontrollers and Applications	--	--	2	1	--	50	--	--	50
ET316	Electronic Software Lab-III	--	1	2	2	--	--	--	25	25
Sub Total		--	1	8	5	--	150		25	175
Grand Total		**18**	**3**	**8**	**27**	**150**	**550**		**150**	**850**

Abbreviations: L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, OE-Oral Examination, POE- Practical Oral Examination
ICA- Internal Continuous Assessment ESE - University Examination (Theory &/ POE &/Oral examination)

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SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Science & Technology

Credit System structure of T.Y. B.Tech. Electronics & Telecommunication Engineering ***W.E.F. 2020-21***

Semester II

Course Code	***Theory Course Name***	***Hrs./week***			***Credits***	***Examination Scheme***			
		L	***T***	***P***		***ISE***	***ESE***	***ICA***	***Total***
ET321	Antenna & Wave Propagation	4	--	--	4	30	70	25	125
ET322	Embedded System	4	--	--	4	30	70	25	125
ET323	Electronic System Design	4	--	--	4	30	70	25	125
ET324	Advanced Mobile Communication	3	1	--	4	30	70	25	125
ET325	Open Elective-II	3	--	--	3	30	70	25	125
SLH32	Self Learning Module II	--	--	--	2	--	50	--	50
Sub Total		18	1	--	21	150	400	125	675
Course Code	***Laboratory Course Name***								
							ESE		
							POE	***OE***	
ET321	Antenna & Wave Propagation	--	--	2	1	--	--	25	--	25
ET322	Embedded System	--	--	2	1	--	50	--	--	50
ET323	Electronic System Design	--	--	2	1	--	#50	--	--	50
ET325	Open Elective-II	--	--	2	1	--	--	--	--	--
ET326	Mini Hardware Project	--	--	2	1	--	--	--	50	50
Sub Total		--	--	10	5	--	125		50	175
Grand Total		**18**	**1**	**10**	**26**	**150**	**525**		**175**	**850**

Abbreviations: L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, OE-Oral Examination, POE- Practical Oral Examination

ICA- Internal Continuous Assessment ESE - University Examination (Theory &/ POE &/Oral examination)

Note - # Practical and Oral Examination of Electronics System Design is combined with Mini Hardware Project.

Note –

1. Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining student exceeds 7, then a new batch shall be formed.
2. Vocational Training (evaluated at Final Year Semester-I) of minimum 15 days shall be completed in any vacation after S.Y. Semester-II but before Final Year Semester-I & the report shall be submitted and evaluated in Final Year Semester-I.
3. Self-Learning Module I at T.Y. B.Tech. – Semester I
   - Student shall select & enroll a Self Learning Module I Course from PAH Solapur University, Solapur HSS Course List (SLH31-A) and appear for university examination.
   - Curriculum for Humanities and Social Sciences (HSS), Self Learning Module - I is common for all under graduate engineering programs.

   OR
   - Student shall select and enroll for university approved minimum eight weeks NPTEL HSS course (SLH31-B), complete its assignments and appear for certificate examination conducted by NPTEL. More details about NPTEL are available at http://nptel.ac.in
4. Self-Learning Module II at T.Y. B.Tech. – Semester II
   - Student shall select a Self Learning Module II (Technical Course) from Course List (SLH32) and appear for university examination.

   OR
   - Student can select & enroll for university approved minimum eight week technical course from various NPTEL technical courses, complete its assignments and appear for certificate examination conducted by NPTEL. More details about NPTEL are available at http://nptel.ac.in
   - Self learning module –II (Technical courses) shall be from the list approved by BOS Chairman at the start of semester.
5. Project group for T.Y. B.Tech. - Semester II Mini Project shall not be of more than **three** students.
6. Project group for Final Year B.Tech - Semester I and Semester II shall not be of more than **three** students.

7. ICA assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, and laboratory books and their interaction and attendance for theory and lab sessions as applicable.
8. Open Elective I & II shall be common and open for the students of the branches – Electronics Engineering, Electronics & Telecommunication Engineering and Electrical Engineering. Students of these branches can take any of these Open Electives. Syllabus and university examination question paper will be same for all these branches.

List of Open Electives -

Sr.	Branch Offering Elective	Open Elective I	Open Elective II
1.	Electronics &Telecommunication Engineering	1. Business Ethics 2. Managerial Economics	1. Optical Communication 2. Sensors & Applications
2.	Electronics Engineering	Information Technology & Management	Operating Systems
3.	Electrical Engineering	Hybrid Electric Vehicle Design	Advanced Control System

Self Learning Module II courses -

1. Computer Organization
2. Renewable Energy Systems
3. Soft Computing
4. NPTEL Courses

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-I

ET311: ELECTROMAGNETIC FIELD THEORY

Teaching Scheme:	**Examination Scheme:**
Lectures – 3 Hours/week, 3 Credits	**ESE – 70 Marks**
Tutorial – 1 Hour/week, 1 Credit	**ISE – 30 Marks**
	ICA- 25 Marks

This course introduces electromagnetic field theory which deals with electric and magnetic field vectors. The course also introduces theoretical and analytical aspects of electromagnetic field, electromagnetic wave propagation and transmission lines.

Course Prerequisite:

Student shall have knowledge Electromagnetics.

Course Objectives:

1. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
2. To familiarize with the different concepts of electrostatic and magneto static fields. To aware students about boundary conditions to different media.
3. To expose the students to the ideas of EM waves and describe the Maxwell's equations.
4. To derive transmission line equations and parameters.
5. To determine transmission line parameters.

Course Outcomes:

At the end of this course, Students will be able to,

1. Define and recognize different co-ordinate systems and apply divergence, gradient, curl to EM waves.
2. Derive the laws of electrostatic, magneto static fields and electromagnetic wave equation.
3. Apply boundary conditions to different media for wave propagation and Maxwell's equations for analysis of wave propagation.
4. Derive transmission line equations, parameters.
5. Apply knowledge of Smith chart to determine transmission line parameters.

Section I

Unit 1: Vector calculus (04)

Scalars and vectors, vector algebra, coordinate system, differential length, surface and volume, point and vector transformations.

Unit 2: Electrostatics (08)

Coulomb's law & electric field intensity, electric field intensity due to distributed charges, flux density, Del operator, Gauss's law and its applications, divergence theorem, electrostatic potential, potential gradient, electric dipole, electrostatic energy density, boundary conditions for electrostatic field.

Unit 3: Static magnetic field (08)

Biot Savart's law, Ampere's circuital law and its applications, Stroke's theorem, magnetic flux density & vector magnetic potential, current carrying conductors in magnetic fields, torque on loop, energy stored in magnetic field, boundary condition for magneto static field.

Section II

Unit 4: Maxwell's equations (07)

Continuity equation for static conditions, displacement current and current density, Maxwell's equations in integral form and point form, Maxwell's equations for static case, time varying field, harmonically varying field.

Unit 5: Electromagnetic wave propagation (06)

Wave propagation in dielectric & conducting media, modification in wave equations for sinusoidal time variations, propagation in good conductor, skin effect, Poynting theorem, power flow in uniform plane wave

Unit 6: Transmission lines (07)

Transmission line sections as circuit elements, Transmission line equations using field theory and circuit theory, transmission line primary constant (R,L,C,G) and secondary (Z_0, γ) constant , the terminated uniform transmission line, reflection coefficient, transmission coefficient, VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Smith Chart and solution of transmission line problems using Smith Chart,.

- **Internal Continuous Assessment (ICA):**

ICA consists of **minimum eight tutorials** based upon above curriculum. Tutorial shall include numerical problems and derivations.

- **Text Books:**

1. Electromagnetic Engineering, William Hyte, 7th Edition, Tata McGraw Hill
2. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill
3. Electromagnetics by John D. Kraus - McGraw Hill Third Edition
4. Electromagnetic field theory & Transmission Lines, GSN Raju, Pearson Education

- **Reference Books:**

1. Electromagnetic Schaum's outline series by J.A.Edminister - Tata McGraw Hill
2. Problems and solutions in electromagnetic, William Hyte, Tata McGraw Hill
3. Electromagnetic Waves and Transmission Lines, Rao, Prentice Hall India Publications
4. Applied Electromagnetics by F. Ulaby (2001 Media Edition) – PHI

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T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-I

ET312 : DIGITAL DESIGN & HDL

Teaching Scheme:	**Examination Scheme:**
Lectures– 4 Hours/week, 4 Credits	**ESE – 70 Marks**
Practical– 2 Hour/week, 1 Credit	**ISE – 30 Marks**
	ICA- 25 Marks
	POE- 50 Marks

This course introduces how to design, simulate and test digital logic circuits using hardware description languages (HDL) VHDL and Verilog HDL. It also describes the CPLD, FPGA and ASIC architectures used to implement the digital logic circuits.

Course Prerequisite:

Student shall have knowledge of Digital components, combinational and sequential logic circuit design.

Course Objectives:

1. To make student learn EDA Tools for VHDL and Verilog programming and simulation.
2. To enable student to design HDL modules for combinational logic circuits.
3. To enable student to design VHDL modules for sequential logic circuits.
4. To acquaint students to CPLD and FPGA architecture, ASIC, SOC and fault testing of combinational and sequential circuits.

Course Outcomes:

At the end of this course, Students will be able to,

1. Explain different syntax of HDL language.
2. Design and analyze combinational logic circuits using VHDL and Verilog.
3. Design and analyze sequential logic circuits using VHDL.
4. Describe architecture and internal components of CPLD, FPGA, ASIC and SOC and compare them.
5. Explain different testing methods for combinational Logic, sequential logic, IC and write test bench for simple combinational circuits.

Section I

Unit 1: Introduction to EDA tool and VHDL programming (10)

About VHDL, Design Flow, EDA tools, Library declaration, entity, architecture, data types, operators, signals, variables, constants, attributes, concurrent code, sequential code, delays, architecture modeling, components, generate, Libraries, IEEE standard logic, packages, generic, functions, procedures, operator overloading, assert.

Unit 2 : VHDL modules for combinational and sequential logic design. (08)
Half & full Adder and Subtractor, multiplexer, demultiplexer, encoder, decoder, comparator, 4-bit adder, array multiplier, latches, flip flops, counter (Synchronous and asynchronous), shift register, static RAM, ROM.

Unit 3 : Verilog modules for combinational logic design. (06)
Introduction to Verilog HDL, Structure of Verilog module, Types of models, Data types, Operators, HDL Implementation of Half Adder, Full Adder, Half subtractor, Full subtractor, encoder, decoder, multiplexer, demultiplexer, comparator.

Section II

Unit 4 : State Machines (08)
State machine using Moore and Mealy model, VHDL model using state machine for sequence detector, Traffic light controller, coffee vending machine, multiplier using ADD and SHIFT method.

Unit 5 : Testing of Logic Circuits (08)
Testing combinational and sequential logic, Boundary scan, Built In Self-test, Test bench for Combinational design for binary adder, comparator, encoder, decoder, multiplexer and demultiplexer.

Unit 6 : Architecture of Commercial Devices: (08)
CPLD Architecture, Xilinx XC9500, Altera Max7000, FPGA organization and architecture, Altera Flex 10k, ASIC and System on Chip architecture.

- **Internal Continuous Assessment (ICA):**

ICA shall be based on minimum ten programs based on above curriculum using suitable EDA tools.

Suggested List of Practicals:

1. Design of half adder and full adder using VHD and Verilog.
2. Design of 4 bit adder using structural style modeling using VHD and Verilog.
3. Design of carry look ahead adder using VHDL.
4. Design of code converters using VHDL or Verilog.
5. Design of comparators using VHDL or Verilog
6. Design of encoder and decoder using VHDL or Verilog
7. Design of multiplexer and demultiplexer using VHDL or Verilog
8. Design of flip flops using VHDL.
9. Design of universal shift register using VHDL.
10. Design of asynchronous and synchronous counters using VHDL.
11. Design of sequence detector using state machine using VHDL.
12. Design of Traffic light controller using state machine editor using VHDL.

13. Frequency multipliers and dividers using VHDL.
14. Design of ALU using VHDL.
15. Design of RAM with read write control using VHDL.
16. Writing test bench for adder, encoder using VHDL.
17. Implement any VHDL module on CPLD or FPGA

- **Text books:**

1. Circuit Design and Simulation with VHDL, Volnei A. Pedroni, PHI
2. Fundamentals of Digital logic Design with VHDL, Brown,Vranesic – McGraw-Hill (2^{nd}edition).
3. Digital Systems Design using VHDL, Charles H. Roth, Lizy Kurian John- Cengage Learning, Second Edition
4. Digital Systems Design using Verilog, Charles H. Roth, Lizy Kurian John, Byeong Kil Lee- Cengage Learning
5. HDL Programming VHDL and Verilog, Nazeih M. Botros, Dreamtech Press.

- **Reference Books:**

1. Digital Design Principles and Practices, John F. Wakerly, Printice Hall, 3^{rd} Edition.
2. Datasheets of CPLDs and FPGAs.

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T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-I

ET313: DIGITAL SIGNAL PROCESSING

Teaching Scheme:	**Examination Scheme:**
Lectures– 4 Hours/week, 4 Credits	**ESE: 70 Marks**
Practical – 2 Hours/week, 1 Credit	**ISE: 30 Marks**
	ICA: 25 Marks
	POE: 50 Marks

The digital computers are large and expensive as a result their use was limited to general purpose Application. The development of powerful, smaller, faster and cheaper digital circuits and are performing complex digital processing functions and tasks. This course covers basic analysis tools and techniques for digital signal processing of signals. This course also presents design and implementation of Finite and Infinite Impulse Response Filter and also applications of DSP.

Course Prerequisite:

Student shall have knowledge of signals and system, basic knowledge of mathematics and transforming tools like Fourier transform, Laplace and Z-transform.

Course Objectives:

1. To interpret the concept of stability in the DSP system.
2. To analyze the given signal and convert time domain to frequency domain and vice versa using FT and Z transforming tools.
3. To draw the structure for realization of a given system.
4. To design FIR and IIR filters.
5. To describe audio, Telecommunication and Radar processing applications of DSP.

Course Outcomes:

At the end of this course, Students will be able to,

1. Solve problems based on Correlation and DFT
2. Analyze response of the system using linear filtering
3. Calculate FFT of the Discrete signal
4. Calculate and analyze FIR & IIR filter coefficients using different techniques.
5. Realize transfer function of FIR & IIR filters using different methods
6. Apply concepts of DSP in various applications

Section I

Unit 1 : Introduction (03)

Introduction to DSP system, co-relation and its properties, Digital transfer function, stability Consideration.

Unit 2 : Discrete Fourier Transform (10)

Frequency Domain Sampling and Reconstruction of Discrete Time Signals, DFT as linear Transformation, relation between DFT and Z transform, Properties of DFT, Computation of DFT & IDFT, multiplication of two DFTs and circular convolution.

Unit 3 : Linear Filtering Method Based on DFT (05)

Use of DFT in linear filtering, Filtering of long data sequences such as Overlap-save and Overlap add method, Frequency analysis of signals using DFT.

Unit 4 : FFT Algorithm (06)

Radix-2 FFT algorithm for the computation of DFT and IDFT, decimation in time (DIT) and decimation in frequency (DIF) algorithms. Goertzel algorithm.

Section II

Unit 7: Realization of Digital Linear Systems (07)

Structures for realization of Discrete time systems
Structures for FIR Filters: Direct form, Cascade form & Lattice Structure.
Structures for IIR Filters: Direct form, Cascade form & parallel form.

Unit 5 : FIR Filter Design (07)

FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming windows, FIR filter design using frequency sampling technique, FIR Implementation techniques.

Unit 6 : IIR Filter Design (07)

IIR Filter Design by Impulse Invariance, IIR Filter Design by Bilinear Transformation (problems on filter design up to 3^{rd} order only) Characteristic of Butterworth filter. IIR implementation technique.

Unit 8 : Application (03)

Application of DSP in Audio processing, telecommunication & Radar signal processing

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Internal Continuous Assessment:

Minimum ten experiments as follows.

1. Introduction to MATLAB /Scilab.
2. Waveform generation using discrete time signals using MATLAB/Scilab.
3. To implement auto co-relation and cross co-relation using MATLAB/Scilab
4. To implement linear convolution using MATLAB/Scilab and C-language.
5. Implementation of DFT and IDFT using MATLAB/Scilab and C-language.

6. To implement circular convolution using MATLAB/Scilab and C-language.
7. Fast convolution using Overlap add/Overlap save method using MATLAB/Scilab.
8. Realization of FIR system.
9. Realization of IIR system.
10. Design of FIR filter using frequency sampling method.
11. Design of FIR filter using windowing technique.
12. Design of IIR filter using impulse invariant technique.
13. To design Butterworth filter using Bilinear transformation technique.

- **Text Books:**

1. Digital Signal Processing – Principles, Algorithms and Applications John G Proakis- 4th edition, Pearson Education
2. Digital Signal Processing by S Salivahanan, A Vallavaraj & C Gnanapriya –2nd edition, TMH.
3. Discrete time signal Processing A.V. Oppenheim & R.W. Schafer.- Low price edition, John Wiley

- **Reference Books:**

1. Digital Signal Processing Ramesh Babu -4th Edition, Scientic Publication.
2. Digital Signal ProcessingDr. Shaila D. Apte, Second edition, Wiley India.
3. Essentials of Digital Signal Processing using MATLABVinay K. Ingle & John G. Proakis, Cengage Learning, 2012
4. Digital Signal Processing- A Practical Approach,E. C. Ifleachor and B. W. Jervis, Second Edition, Pearson education.
5. Theory and Application of Digital Signal Processing DigitalRabiner& Gold-First edition, Prentice Hall
6. Digital Signal ProcessingS. Palani& D. Kalaiyarasi, Ane's Student Edition, Ane Books Pvt. Ltd New Delhi

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T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-I

ET314: MICROCONTROLLERS AND APPLICATIONS

Teaching Scheme:	**Examination Scheme:**
Lectures– 4Hours/week, 4 Credits	**ESE – 70 Marks**
Practical – 2 Hours/week, 1 Credit	**ISE –30Marks**
	ICA-25 Marks
	POE- 50Marks

This course introduces Basics of microcontroller's theory which includes internal details of MCS51 series and PIC Microcontroller. The course also introduces Assembly level as well Embedded C Level programming aspects of both microcontrollers, Memory interfacing and Interfacing various I/O devices.

Course Prerequisite:

Student shall have knowledge of Digital Electronics.

Course Objectives:

1. To provide an introduction to microcontroller families and details of MCS51.
2. To describe Core features and Peripheral features of PIC16f877a
3. To explain and practice assembly language and Embedded C programming techniques
4. To demonstrate and perform hardware interfacing and design for various applications.

Course Outcomes:

At the end of this course, Students will be able to,

1. Expose the fundamental features and operation of contemporary microcontroller
2. Demonstrate and perform hardware interfacing.
3. Explore the students to the fundamentals of PIC Microcontroller 16F877 architecture
4. Introduce the various core and peripheral features in PIC Microcontroller 16F877.
5. Develop and practice assembly language and C language programming techniques

Section I

Unit 1: Introduction Microcontroller (04)

Introduction, Microprocessor and Microcontrollers, CISC & RISC Microcontroller, Harvard and von Neumann architecture, Development system for Microcontroller.

Unit 2: The 8051 Architecture and Instructions (08)

8051 Microcontroller Hardware, Addressing modes, Instruction set ,Input / Output Pins, ports and Circuits, External Memory, Counters and Timers, Serial Data Input/ output, interrupts.

Unit 3: Programming Microcontroller (8051) (06)

The mechanics of Programming, The assembly Language and C programming concepts, Serial Port Programming, Timer Programming and Interrupt Programming, Program for interfacing Switches, LED, Relay, Buzzer.

Unit 4: Interfacing with microcontroller (06)

LCD display, Matrix keyboard, ADC 0809, DAC 0808, Stepper Motor, Interfacing External Memory

Section II

Unit 5: PIC Microcontrollers: (04)

PIC Microcontrollers Introduction, Architecture, features, Configuration word and Instruction Set

Unit 6: PIC 16F877A Microcontroller Core Features :(08)

Functional pin description, various registers, Program memory and data memory organization, Input / output ports, Interrupts, various kinds of RESET

Unit 7: Peripheral Features and Programming: (06)

Timers, Capture/ compare / PWM (CCP) Modules in PIC 16F877, Internal ADC, The Watchdog Timer.

Unit 8: Serial Communication: (06)

Master synchronous serial port (MSSP) module: SPI, I2C, The Universal Synchronous Asynchronous Receiver Transmitter (USART) module.

- **Internal Continuous Assessment (ICA):**
  ICA consists of minimum ten Practical based upon above curriculum.
  Students should be introduced to embedded C programming and Minimum Four practical's should be taken using embedded C programming

Suggested List of Practical:

1. Arithmetic and Logic operations
2. Interfacing of Switches, LEDs and Buzzer.
3. Interfacing of Matrix Keyboard
4. Interfacing of LCD Display.
5. Interfacing of DAC 0808 and generation of various waveforms.
6. Interfacing of ADC 0809
7. Use of Timer for generation of time delays
8. Use of Timer as counter.
9. Interfacing of Stepper motor.
10. Speed control of DC Motor using PWM.
11. Use of ADC of PIC Microcontrollers.
12. Use of Interrupts for any Application.
13. Use of CCP Module of PIC Controller
14. Serial communication.
15. Study of any one Industrial application using Microcontroller.

- **Text Books:**

1. The 8051 Microcontroller Architecture, programming and Applications by Kenneth Ayala Penram International (Third Edition)
2. The 8051 Microcontroller and Embedded systems by Muhammad Ali Mazidi Pearson Education Asia LPE (Second Edition)
3. Designs with PIC Microcontrollers by John B. Peatman Pearson Education Asia LPE
4. PIC Microcontroller & Embedded Systems – Mazidi – Pearson Education
5. Microcontrollers [Theory and Applications] by Ajay V Deshmukh- Tata McGraw Hill Education.

- **Reference Books:**

1. 8051 Microcontrollers programming and practice by Mike Predcko.
2. Data sheets of MCS51 family microcontrollers, PIC 16F877A Flash microcontrollers,
3. 8051 Microcontroller by I Stott, Mackenzie, Rathel & Phan – Fourth Edition - Pearson
4. Designing & Customizing of PIC Microcontrollers by Mike Predcko.

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T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-I

ET315.1: OPEN ELECETIVE-I

BUSINESS ETHICS

Teaching Scheme:	**Examination Scheme:**
Lectures– 3Hours/week, 3 Credits	**ESE – 70 Marks**
Tutorial – 1 Hour/week, 1 Credit	**ISE –30Marks**
	ICA-25 Marks

This course introduces basics of business ethics and its related. The course also introduces theoretical aspects of ethical issues related to stakeholders

Course Prerequisite:

Student shall have knowledge basic management principles.

Course Objectives:

1. To make students aware of basics of business ethics and related theories
2. To understand different tools for decision making and management in business ethics
3. To get acquainted with corporate and ethical issues related with it
4. To understand different ethical issues related to various stakeholders

Course Outcomes:

At the end of this course, Students will be able to,

1. Elaborate concepts of ethics and related theories
2. Describe and apply tools for decision making and management in business ethics
3. Understand and form the ethical issues in corporation
4. Understand and identify the ethical issues from various stakeholders' point of context

Section-I

Unit 1: Introduction (06)

Business Ethics: An overview, importance of Business Ethics, Key context- Globalization, sustainability, Normative ethical theories and descriptive ethical theories and contemporary ethical theories

Unit 2: Decisions and management of business ethics (06)

Models of ethical decision making, Individual and situational influences on decision making, business ethics management, Setting standards of ethical behavior, Managing stakeholder relations, Assessing ethical performance, Organizing for Business Ethics management

Unit 3: Framing business Ethics (06)

Framing Business Ethics- CSR, stakeholders and Citizenship, Corporation- key features, CSR, Stakeholder theory of firm, Corporate accountability, Corporate citizenship, understanding corporate governance and ethical issues

Section-II

Unit 4: Employees, consumers and business ethics (07)
Models of organization, Employees as stakeholders, Ethical issues in the firm-employee relation, Ethical challenges of globalization, corporate citizen and employee relations towards sustainable employment. Consumers as stakeholders, Ethical issues, marketing and the consumer, Globalization and consumers, Consumers and corporate citizenship, Sustainable consumption

Unit 5: Civil Society and Environment (07)
Civil society organizations as stakeholders, Ethical issues and CSOs, Globalization and CSOs, Corporate Citizenship and civil society, Civil society, business and sustainability, Business Ethics and Environmental values, The dimensions of pollution and resource depletion, Ethics of pollution control, Ethics of conserving depletable resources

Unit 6: IT and Government (07)
Information technology and its moral significance to business, IT code of conduct, Data identity and security, Crime and punishment, Government as stakeholder, Ethical issues in the relation between business and government, Globalization and business- government relations, Corporate Citizenship and regulation, Governments, business and sustainability

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- **Internal Continuous Assessment (ICA):**

ICA consists of minimum eight tutorials based upon above curriculum. Tutorial shall include case studies related to context like employee, civil citizens, environment, consumer etc. It will be motivated to have seminars and role plays for various case studies related to ethical issues. Visits to various organizations and reports based on that can be considered.

- **Text Books:**

1. Business Ethics by Andrew Crane, Dirk Matten, Oxford University press

- **Reference Books:**

1. Business Ethics: Ethical Decision Making and Cases, O. C. Ferrell, John Fraedrich, Linda Ferrell, Cengage Publication
2. Business Ethics Methods and Application, Christian U. Becker, Taylor and Francis
3. Business & Society: Ethics and Stakeholder Management, Archie B. Carroll, Ann K. Buchholtz, Cengage Publication 7th Edition

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T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-I

ET315.2: OPEN ELECETIVE-I

MANAGERIAL ECONOMICS

Teaching Scheme:	**Examination Scheme:**
Lectures– 3Hours/week, 3 Credits	**ESE – 70 Marks**
Tutorial – 1 Hour/week, 1 Credit	**ISE –30Marks**
	ICA- 25 Marks

This course introduces basics of economics and concepts related to economics. The course also introduces theoretical and practical aspects of decision making for managers.

Course Prerequisite:

Student shall have knowledge basic management principles.

Course Objectives:

1. To make students aware to concepts of managerial economics
2. To introduce students to concepts of demand, supply and market
3. To introduce different tools for demand analysis and forecasting
4. To make students aware about production and cost functions
5. To make students aware about correlation of pricing with market, demand and supply

Course Outcomes:

At the end of this course, Students will be able to,

1. Elaborate the concepts of managerial economics
2. Analyze the issues related to demand, supply and market
3. Use different tools for demand analysis and forecasting
4. Analyze the production and cost functions
5. Decide price on the basis of market, demand and supply

Section – I

Unit 1: Introduction: (06)

Introduction to Economics, Introduction to Managerial Economics, Economics contribution to managerial decision, Scope of Managerial Economics – Microeconomics and Macroeconomics, Basics of Mathematical Tools – Statistics and Operational Research

Unit 2: Demands, Supply and Market Equilibrium (08)

Demand, Supply, Market Equilibrium, Measuring value of market exchange, changes in market equilibrium, Price ceilings and Price floors, Meaning of demand, Demand utility, Approaches to consumer demand analysis, Analysis of consumer behavior – Cardinal behavior and ordinal approach

Unit 3: Demand and Market Analysis (06)

Price Elasticity of Demand, Price Elasticity, Total Revenue and Marginal Revenue, Factors Affecting Price Elasticity, Cross Price Elasticity, Income Elasticity of Demand, Other Elasticities, Elasticities for Nonlinear Demand Functions, Elasticity of Supply

Section – II

Unit 4: Tools for Demand Forecasting (08)

Survey Methods – Consumer survey and Opinion Poll, Statistical Method – Trend Projection, Barometric Method, Econometric Method, Simultaneous equation, Linear Regression Model, Multiple Regression, Non-linear Regression, Basic concepts used in Linear Programming, Application of Linear Programming Techniques

Unit 5: Production and Cost Analysis (06)

Introduction to Production, Production Function, Theory of cost concepts, Cost of Production, Breakeven analysis- Linear, Non-linear, Profit Margin of Safety

Unit 6: Market Structure and Pricing Decision (06)

Concept of Market, Demand side of market, Supply side of Market, Market Structure and Degree of Competition, Pricing Decision and Monopoly Power

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- **Internal Continuous Assessment (ICA):**

  ICA consists of minimum eight tutorials based upon above curriculum. Tutorial shall include case studies related to above curriculum.

- **Text Books:**

1. Managerial Economics by D. N. Dwivedi – 8th Edition- Vikas Publications
2. Managerial Economics Foundations of Business Analysis and Strategy- C. R. Thomas & Maurice – 8th Edition- McGraw Hill

- **Reference Books:**

1. Managerial Economics Concepts and Applications - C. R. Thomas & Maurice – 8th Edition- MCGraw Hill

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Semester-I

ET316: ELECTRONIC SOFTWARE LAB-III

Teaching Scheme:
Practical – 2 Hours/week, 1 Credit
Tutorial – 1 Hour/week, 1 Credit

Examination Scheme:
ICA- 25 Marks

This course will introduce fundamental programming concepts including data structures, networked application program interfaces, and databases, using the Python programming language.

Course Prerequisite:

Basic knowledge of programming concepts like Variables, Loops, Control Statements, etc in any programming language like C.

Course Objectives:

1. Introduce procedural and object-oriented style for writing Python scripts.
2. Introduce standard library packages and modules in Python.
3. To teach testing, debugging and profiling of Python scripts.

Course Outcomes:

At the end of this course, Students will be able to,

1. Write Python scripts using procedure and object oriented approach of writing a computer program.
2. Exhibit ability to use Python's standard library packages to provide solution to a given problem.
3. Test and debug python script for a given problem.

Section – I

Unit 1: Introduction to Python (02)

Introducing the Python Interpreter, Program Execution, Execution Model Variations, TheInteractive Prompt, System Command Lines and Files. Syntactic and semantic differences between Python 2.x and Python3.x.

Unit 2: Introduction to Python Programming Constructs (04)

Data types and variables, Collection data types, Control structures, loops and functions, Lambdas, Generators, Exception Handling, String handling, Scope of variables, Modules, Packages, Command line arguments. Built-in: Functions, Constants, Types, Exceptions.

Unit 3: Introduction to Object Oriented Programming in Python (04)

Classes, Instance Objects, Method Objects, Class and Instance Variables, Attributes and methods, Inheritance and polymorphism

Section – II

Unit 4: Python Standard Library Modules and Packages -1 (06)

Common string operations, Regular expression operations, Basic date and time types, General calendar-related functions, Container datatypes, Efficient arrays of numeric values, Dynamic type creation and names for built-in types, Shallow and deep copy operations, Mathematical functions, Generate pseudo-random numbers, Functional Programming Modules, File and Directory Access

Unit 5 : Python Standard Library Modules and Packages -2 (06)

Data Persistence: Python object serialization, DB-API 2.0 interface for SQLite databases. Work with ZIP archives, CSV File Reading and Writing, Configuration file parser, Logging facility for Python.

Concurrent Execution: Thread-based parallelism, Process-based parallelism, Context Variables, Asynchronous I/O.

Low-level networking interface, JSON encoder and decoder, URL handling modules, urlib, HTTP modules, HTTP protocol client.

Unit 6: Testing, Debugging and Profiling (04)

Testing output, Unit tests in Python, Handling Multiple exceptions, Creating custom exceptions, Debugging programs, Unit testing, Measure execution time of small code snippets, Creation of virtual environments, System-specific parameters and functions and profiling Python scripts.

- **Internal Continuous Assessment (ICA):**

1. Students should undertake minimum of 12 practical/assignments based on each of above topic.
2. The assignments should test and develop student's practical proficiency and ability to use Python standard library modules and packages efficiently in writing effective code for varied applications scenarios & requirements, usecases.
3. Use of IDEs like PyCharm, Eclipse with PyDev, Jupyter Notebook for Interactive development and debugging of Python applications is highly recommend to enhance hands on skills in Python Programming of Students.
4. Every assignment shall be performed under Python 2.x or 3.x runtime environment configured using any of the following tools 1) pyenv 2) virtualenv 3) Anaconda

- **Text Book:**

1. e-Resource : Python 2.7.16 documentationhttps://docs.python.org/2/
2. e-Resource : Python 3.7.3 documentationhttps://docs.python.org/3/
3. Programming in Python 3, Second Edition, Mark Summerfield

- **Reference Books:**

1. Python Cookbook, Third Edition, David Beazley and Brian K. Jones, Shroff Publishers & Distributors Pvt. Ltd., ISBN :978-93-5110-140-6
2. Learning Python FIFTH EDITION Mark Lutz
3. Programming Python (English) 4Th Edition Mark Lutz
4. Testing Python, David Sale, Wiley India (P) Ltd., ISBN :978-81-265-5277-1

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T. Y. B.Tech (Electronics& Telecommunication Engineering)

Semester-II

ET321: ANTENNA AND WAVE PROPOGATION

Teaching Scheme:	**Examination Scheme:**
Lectures– 4 Hours/week, 4 Credits	**ESE – 70 Marks**
Practical – 2 Hours/week, 1 Credit	**ISE –30 Marks**
	ICA- 25 Marks
	OE- 25 Marks

This course introduces Antenna and Wave Propagation which deals with different types of antenna, and propagation of wave over ground and through atmosphere. The course also introduces theoretical and analytical aspects of wave propagation and radiating system.

Course Prerequisite:

Student shall have knowledge of Electromagnetic Fundamentals.

Course Objectives:

The student will learn and understand

1. Basics of antenna
2. Various types of antenna and radiation mechanism of antenna
3. Techniques used for antenna parameters measurement
4. Wave propagation over ground, through troposphere and inosphere.

Course Outcomes:

At the end of this course, Students will be able to,

1. Identify basic antenna parameters.
2. Analyze radiation pattern of various antennas.
3. Illustrate techniques for antenna parameter measurements.
4. Identify the characteristics of radio wave propagation.
5. Understand the various applications of antenna.

Section-I

Unit 1:Antenna Fundamentals: (06)

Comparison between an antenna & transmission line, Radiation Principle, Antenna parameters: Beam area, Beam width, Polarization, Radiation Intensity, Beam Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, Antenna aperture-physical and effective apertures, effective height, antenna field zones.

Unit 2: Antenna Arrays: (08)

Arrays of two isotropic point sources, non isotropic Sources, principle of pattern multiplication, linear arrays of n elements, Broadside, End-fire radiation pattern, directivity, Beam-width and null directions, array factor.

Unit 3: HF, VHF and UHF Antennas: (10)

Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Radiated Power, Radiation Resistance.

Helical Antennas: Helical geometry, transmission and radiation modes, wide band characteristics of helical antenna.

Slot antenna: Patterns of slot antenna, Babinet's principle and complementary antennas, impedance of slot antennas. (Excluding mathematical derivations for Helical and Slot Antennas. The problems on Helical and Slot Antennas will be included.)

Section-II

Unit 4: UHF and Microwave Antennas: (08)

Important horn shapes, Design equation of horn antenna, Optimum Horn, Uses of horn antenna.

Reflector Antennas: Introduction, Plane Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods.

Microstrip Antennas: Introduction, Advantages and Limitations, Various microstrip patch configurations, Radiation mechanism, Feeding techniques, Applications of microstrip antenna.

Unit 5: Special Antennas: (06)

Introduction of frequency independent antennas –Spiral antenna, Log periodic antenna, Modern antennas- Reconfigurable antenna, Active antenna, Smart antenna.

Antenna Measurements: Measurement of Gain, Radiation pattern and Polarization.

Unit 6: Radio Wave Propagation: (10)

Modes of propagation, structure of atmosphere, ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, flat earth and curved earth concept. Sky wave propagation- Virtual Height, Critical frequency, Maximum usable frequency, Skip distance, Fading, Multi hop propagation.

- **Internal Continuous Assessment (ICA):**

  ICA consists of minimum eight practicals from given list

  Suggested List of Practicals:

1. To plot radiation pattern of dipole antenna and calculate its parameters
2. To plot radiation pattern of monopole antenna and calculate its parameters
3. To plot radiation pattern of Helical antenna and calculate its parameters
4. To plot radiation pattern of Log periodic antenna and calculate its parameters
5. To plot radiation pattern of parabolic reflector and calculate its parameters
6. To plot radiation pattern of horn antenna and calculate its parameters
7. To plot radiation pattern of slot antenna and calculate its parameters
8. To plot radiation pattern of Broadside array and calculate its parameters
9. To plot radiation pattern of End fire array and calculate its parameters
10. To plot 2-dimensional and 3-dimensional radiation pattern of directional antenna using simulation software.

- **Text Books:**

1. Antennas for All Applications – John D. Kraus and R. J. Marhefka, and Ahmad S. Khan TMH, New Delhi, 4th ed., (Special Indian Edition) 2010. Electromagnetic field theory & Transmission Lines, GSN Raju, Pearson Education
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition 2000

- **Reference Books:**

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, SatyaPrakashan, Tech India Publications, New Delhi, 2001.
3. Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
4. Antennas – John D. Kraus, McGraw-Hill (International Edition), 2nd Ed. 1988.

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T. Y. B.Tech (Electronics& Telecommunication Engineering)
Semester-II

ET322: EMBEDDED SYSTEMS

Teaching Scheme:
Lectures– 4 Hours/week, 4 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme:
ESE – 70 Marks
ISE –30Marks
ICA -25 Marks
POE - 50Marks

This course introduces Embedded System Design with software and hardware perspective. The course also introduces practical design aspects of embedded system.

Course Prerequisite:
Student shall have knowledge digital circuits, basic C programming, Microcontroller fundamentals.

Course Objectives:
1. To make student realize different aspects and application areas of embedded systems.
2. To make student understand ARM core architecture.
3. To make student understand interfacing of input & output devices
4. To introduce to student concepts of Real time operating system.

Course Outcomes:
At the end of this course, Students will be able to,
1. Student can describe hardware and software architecture of embedded system.
2. Student can describe ARM7TDMI core architecture and Controller based on this architecture
3. Student can write C program for different applications for LPC2148microcontroller.
4. Student can interface different peripherals with LPC2148 microcontroller.
5. Student can describe microcontroller based real time systems for different applications.

Section - I

Unit 1: Embedded System Introduction (06)
Introduction to Embedded System, History, Design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions.

Unit 2: System Architecture (10)
Introduction to ARM7TDMI core architecture, ARM extension family, Pipeline, LPC 2148, ARM instruction set, thumb instruction set, memory management, Bus architecture.

Unit 3: On Chip Peripherals (08)
Study of on-chip peripherals like I/O ports, PLL, timers / counters, interrupts, on-chip ADC, DAC, RTC module, WDT, PWM, USB.

Section – II

Unit 4: Interfacing and Programming (10)

Introduction to Embedded C Programming, Basic embedded C programs for on-chip peripherals studied in system architecture like PLL, timers, ADC, WDT, PWM. Interfacing of devices – LED, Switches (buttons),4 x 4 Matrix Keypad, 7-segment display, LCD display, DC motor.

Unit 5: Real Time Operating System (10)

Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS, introduction to µcosII.

Unit 6: Case Studies (04)

Case studies like Digital Camera, Smart Card System based ATM and Mobile Internet Device.

Internal Continuous Assessment:

ICA consists of 8 to 10 practical's based upon above curriculum.

List of Practical's:

1. Arithmetic and Logic operations
2. Interfacing of Switch, LED / Buzzer / Relay
3. Interfacing of LCD Display.
4. Interfacing matrix Keypad and display key pressed on LCD / Seven Segment Display
5. Use of Timer for generation of time delays
6. Use of Interrupts for any Application
7. Use of ADC of Microcontroller.
8. Interfacing of Stepper motor.
9. Interfacing of DC Motor.
10. USART Serial communication.
11. Creating two tasks, which will print some characters on the serial port, Start the scheduler and
12. observe the behavior.
13. Implementing a semaphore for any given task switching using RTOS on microcontroller board.
14. Implementing a Mailbox for task communication.

- **Text books:**

1. Embedded Systems: Architecture, Programming And Design by Rajkamal Tata McGraw-Hill Education
2. Frank Vahid - Embedded Systems - Wiley India
3. ARM System Developer's Guide, Designing and Optimizing System Software - Andrew N. Sloss , Dominic Symes, Chris Wright - Morgan Kaufmann Publisher.
4. Embedded systems software primer - David Simon – Pearson
5. MicroC / OS-II, Jean J Labrose - Indian Low Price Edition

- **Reference Books:**

1. DR.K.V.K.K. Prasad - Embedded / real time system – Dreamtech
2. Embedded real systems Programming – Iyer, Gupta, TMH
3. Embedded systems: a contemporary design tool, James K. Peckol- Wiley India
4. Datasheet of LPC 2148.
5. Application Handbook of Embedded System

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Semester-II

ET323 : ELECTRONIC SYSTEM DESIGN

Teaching Scheme	**Examination Scheme**
Lectures– 4 Hours/week, 4 Credits	**ESE – 70 Marks**
Practical – 2 Hour/week, 1 Credit	**ISE –30 Marks**
	ICA– 25 Marks
	POE – # 50 Marks

This course introduces construction, characteristics of power electronics devices and its applications. The course also introduces design of different electronics systems such as frequency synthesizer, frequency counter, time period measurement. This course also covers design of industrial controllers and aspects of PLC & automation.

Course Prerequisite:

Student shall have knowledge of Basic Electronics, Linear Integrated Circuits and Digital Electronics

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Course Objectives:

1. To describe the concept and applications of power electronic devices.
2. To design and analyze timer, frequency counters and digital voltmeters.
3. To design applications of Phase Locked Loop (PLL) and industrial process control.
4. To provide introduction of the concept of PLC and its applications.

Course Outcomes:

At the end of this course, Students will be able to,

1.Describe construction, working & analyze characteristics of thyristors.

2.Analyze AC and DC power control circuits using thyristors.

3. Design and implement timers, frequency counters, digital voltmeters and frequency synthesizers.

4.Design and simulate Communication system components for system design.

5.Design and analyze controllers for industrial applications.

Section I

Unit 1: Introduction to Power Semiconductor Devices (08)
SCR - construction, working, VI characteristics, turn on and turn off methods (Class A, B, C, D). TRIAC - construction, working, VI Characteristics. DIAC - construction, working, VI Characteristics.

Unit 2: Power Electronics Applications (08)
Single phase half wave controlled rectifier, center tapped full wave controlled rectifier, fully controlled bridge rectifier, AC power control using DIAC & TRIAC and its applications.

Unit 3: Modulator, Demodulator & PLL (09)
Balanced modulator principle, IC 1596, applications of IC 1596 as AM modulator & Mixer. PLL-Working Principle, design consideration, FM detector, FSK demodulator, PSK demodulator, design of frequency synthesizer using LM565.

Section II

Unit 4: Timer, Counters &Digital Voltmeter (09)
Design of Timer using XR 2240, Design of counter using IC 74C926 for the time & event counting, Design of 3 ½ digit Multi-range DVM using discrete components.

Unit 5: Design of Industrial Control (08)
Signal conditioning for sensors PT 100, LM 35, Thermocouples (J & K type), current loop Interface (4mA to 20mA), zero & span circuit, offset V to I & I to V converter, V to V converter.

Unit 6: Controllers (08)
Design of analog ON/OFF controller and proportional controller for controlling process, PLC architecture and applications, bottle filling plant & elevator control.

Note - # Practical and Oral Examination of Electronics System Design is combined with Mini Hardware Project.

• Internal Continuous Assessment:
ICA consists of minimum eight practical from following suggestive list.

Suggestive List of Practicals:
1. VI Characteristics of SCR.
2. VI characteristics of TRIAC & DIAC.
3. Single phase half wave controlled rectifier.
4. Lamp dimmer using TRIAC & DIAC.
5. AM simulation using MATLAB SIMULINK.
6. PLL application using MATLAB SIMULINK.
7. Implementation of frequency division circuit using IC.
8. Application implementation using PLC.
9. Temperature controller using OPAMP.

10. V to V Converter.
11. Simulation of Display design.
12. Design and simulate 3 ½ digit DVM.

- **Text Books:**

1. Power Electronics, circuits, devices & applications by M. H. Rashid, Pearson Education, 3rd edition.
2. Power Electronics by P. C. Sen, TATA Mc. Graw Hill, 2nd Edition.
3. Power Electronics by M. D. Singh & K. B. Khanchandani, TATA Mc. Graw Hill, 2nd Edition.
4. Introduction to System Design Using Integrated Circuits by B. S. Sonde, NewAge International Publishers, 2nd Edition.

• Reference Books:

1. Integrated Circuits by K. R. Botkar, Khanna publishers, 10th Edition.
2. Programmable Logic Controllers by Job Den Otter, Prentice Hall International Editions.
3. Programmable Logic Controllers by John Web & Ronald Reis, PHI Publications, 5th edition.
4. Process Control Instrumentation Technology by Curtis. D. Joshon, Pearson Education, 8th edition.
5. Data sheets of Analog and digital ICs used for design using Web resources.

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Semester-I

ET324: ADVANCED MOBILE COMMUNICATION

Teaching Scheme:	**Examination Scheme:**
Lectures– 3 Hours/week, 3 Credits	**ESE -70 Marks**
Tutorial – 1 Hour/week, 1 Credit	**ISE - 30 Marks**
	ICA -25 Marks

This course introduces Advanced ideas, design principles, architectures and technology standards used in advanced mobile communication systems.

Course Prerequisite:

Student shall have knowledge of basics of analog communication and digital communication.

Course Objectives:

1. To recognize cellular concept in mobile communication.
2. To examine the Mobile radio propagation, cellular system design, and to identify multiple access techniques used in mobile communication
3. To analyze mobile technologies like GSM
4. To categorize the mobile communication evolution of 2G to 5G technologies.
5. To describe overview of 4G & 5G next generation technology.

Course Outcomes:

At the end of this course, Students will be able to,

1. Students will be able to define cellular systems, working and hand off strategies implemented in mobile communication.
2. Students will be able to analyze various losses in mobile radio propagations and define multiple access schemes sharing radio spectrum.
3. Students will be able to define GSM - architecture, frame structure, system capacity and services provided.
4. Students will be able to describe mobile communication evolution of 2G to 5G technologies
5. Students will be able to analyze emerging technologies required for fourth generation mobile systems such as Long Term Evolution(LTE) & 5G next generation technology.

Section I

Unit 1: Introduction (08)

Introduction to wireless communication systems

The Cellular Engineering Fundamentals : Introduction, Frequency Re-use, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of service, Co-channel Interference (CCI), Adjacent Channel Interference (ACI), Cell Splitting, Sectoring, Microcell Zone concept, Repeaters.

Unit 2: Mobile Radio Propagation (07)

Large scale path loss, Free space propagation model, ground reflection model (two ray model), diffraction, Practical Link Budget using path loss model, Small scale fading and multipath small scale multipath propagation.

Unit 3: Multiple Access Technique in Wireless Communications (06)
Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access (SSMA), Space Division Multiple Access (SDMA), Orthogonal Frequency Division Multiple Access (OFDMA)

Section II

Unit 4: GSM (07)
GSM Network architecture, signaling protocol architecture, identifiers, channels, Frame structure, speech coding, authentication and security, call procedure, handoff procedure, services and features. Mobile data networks, GPRS and higher data rates.

Unit 5: CDMA digital cellular standard (IS-95) & IMT – 2020 (07)
Frequency and channel specifications of IS-95, forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management. IMT 2000 & IMT Advanced, IMT 2020, capabilities.

Unit 6: 4G (LTE) & 5G Next Generation Technology (07)
Introduction to 4G, LTE Architecture, Elements of LTE- EPS, LTE Radio / air interface- Modulation and features, LTE Channels, Introduction to 5G, 5G CN Architecture, Radio/air interface, features.

- **Internal Continuous Assessment (ICA):**

- ICA shall include minimum **eight tutorials** based on above syllabus.
- One visit to the **Mobile base station** & submission of report.

- **Text Books:**

1. Wireless Communications - Theodore S. Rappaport, Prentice Hall of India, PTR Publication.
2. Principles of Wireless Networks – Kaveh Pahlavan, Prashant Krishnamurthy, PHI.
3. Mobile Communication – G. K. Behera & Lopamudra Das, Scitech Publication.
4. Mobile Communications – Jochen Schiller, Pearson Education, Second Edition.

- **Reference Books:**

1. Wireless Communication – Singhal, TMH.
2. Mobile and Personal Communication Systems and Services – Raj Pandya, Prentice Hall of India.
3. Wireless Communication – D. P. Agarwal, Thomnson learning 2007, Second Edition.
4. Wireless Communication and Network –Upena Dalal, OXFORD higher Education
5. 4 G Roadmap and Emerging Communication Technologies – Young Kyun Kim and Ramjee Prasad –Artechhouse.
6. 5G NR: The Next Generation Wireless Access Technology- By Erik Dahlman, Stefan Parkvall, Johan Skold

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Semester-I

ET325.1: OPEN ELECTIVE-II
OPTICAL COMMUNICATION

Teaching Scheme:
Lectures– 3Hours/week, 3 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme:
ESE – 70 Marks
ISE –30 Marks
ICA- 25 Marks

This course introduces the basic concept of optical communication. It explains the basic working principle of optical fiber. It covers the study of basic optical devices as optical source, optical detector, optical joints. It also introduces aspects of practical design of optical communication system.

Course Prerequisite:
Student should have knowledge of basic communication system, light reflection, refraction process.

Course Objectives:
1. To make students to understand basic working principle of optical fiber.
2. To introduce to student basic losses in optical fiber & reasons behind the losses.
3. To make students to understand the basics of optical sources(LASER & LED).
4. To make students to understand the basics of optical detectors.
5. To study the concepts of optical networks.

Course Outcomes:
At the end of this course, Students will be able to,
1. Demonstrate working of optical fiber.
2. Explain transmission characteristics of optical fibers & concept of optical joints.
3. Illustrate different optical sources & optical detectors.
4. Solve the numerical to calculate the various parameters of optical sources & detectors.
5. Explain the different types of optical amplifier & optical networks.
6. Analyze the functional blocks in optical communication system.

Section I

Unit 1 : Overview of Optical Fiber Communication (06)

Introduction, Historical development, general optical communication system, advantages, disadvantages, optical fiber waveguides, ray theory ,mode theory, Types of optical fibers, single mode ,multimode fiber, step index & graded index fibers, applications of optical fiber communication.

Unit 2 : Transmission Characteristics of Optical Fibers and Optical Joints (08)
Introduction, Attenuation, absorption- intrinsic & extrinsic, linear &non linear scattering losses, bending loss, dispersion- intermodal & intramodal, Fibers alignment and joint loss, fiber splices, connectors, fiber couplers& its types.

Unit 3 : Optical Source (08)
Laser: Requirements of optical source, basic concept of LASER, optical emission from semiconductors, heterojunction structure, Semiconductor injection laser and structures, Injection laser characteristics, LED: LED structures, LED characteristics, Light Modulation.

Section II

Unit 4 : Optical Detectors (06)
Introduction, requirements of optical detector, optical detection principles, performance parameters of detector- absorption, quantum efficiency, responsivity, cut off wavelength. Semiconductor photo diodes with and without internal gain, PN, PIN, Avalanche Photo diodes, Phototransistors.

Unit 5 : Optical Networks (06)
Optical Networks: Introduction, networking terminology, optical network modes, SONET / SDH, SONET/SDH rings, Optical Ethernet, data buses, Fiber Distributed Data Interface (FDDI).

Unit 6 : Fiber Optical Communication Systems (06)
Introduction, Transmitter Design, Receiver Design, Noise equivalent model of receiver, Link Design, Wavelength Division Multiplexing (WDM), DWDM, Optical Time Division Multiplexing.

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum 8Practicals based upon above curriculum.

Suggested List of Practicals:

1. Setting up fiber optic analog& digital link.
2. Frequency modulation using fiber optic cable.
3. Pulse width Modulation using fiber optic cable.
4. Study of propagation loss in optical fiber.
5. Study of bending loss in optical fiber.
6. Measurement of optical power using optical power meter.
7. Measurement of Numerical Aperture.
8. Transmission of voice signal using FOC.
9. Study of WDM .
10. Study of LED output characteristics.

- **Text Books:**

1. Optical Fiber Communications, John M. Senior, Pearson Education. 3rd Impression, 2007
2. Optical Fiber Communications, Gerd Keiser, 4th Ed., MGH, 2008
3. Optical Fiber Communications ,D.C.Agarwal - S.Chand and company

- **Reference Books:**

1. Optical Communications, David Gover – PHI
2. Fiber Optics communication, HozoldKolimbiris - Pearson Education.
3. Fiber Optics Communication – 5th Edition, Palais-Pearson Education

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Semester-II

ET325.2: OPEN ELECTIVE-II

SENSORS & APPLICATIONS

Teaching Scheme:	**Examination Scheme:**
Lectures– 3 Hours/week, 3 Credits	**ESE – 70 Marks**
Practical – 2 Hours/week, 1 Credit	**ISE –30 Marks**
	ICA- 25 Marks

This course provides good knowledge of working of different types of sensors used in various application areas. This course also provides knowledge of interfacing of electronic circuits with different sensors for its applications in different fields.

Course Prerequisite:

Concept of internal characteristics of passive elements like resistor, capacitor, inductor etc., Diode and transistor working, knowledge of basic fundamentals of mechanical terms like position, strain, stress etc.

Course Objectives:

1. To introduce students with the basics of various sensors and its characteristics.
2. To make students familiar with the working principle of different types of sensors and transducers.
3. To introduce various signal conditioning and smoothing circuits for sensors
4. To familiarize students with different sensor technologies and interfacing techniques.
5. To introduce students with the concept of actuators.

Course Outcomes:

At the end of this course, Students will be able to,

1. Elaborate the concept of sensors and its characteristics.
2. Describe the working principle of analog and digital sensors.
3. Design sensor interface circuits for a given engineering problem.
4. Select an appropriate sensor for a given engineering application based on interface technique, material and technology of a sensor.
5. Describe the working principle of different types of actuators.

Section I

Unit 1: Sensors Fundamentals and Characteristics (06)

Sensors, Signals and Systems, Sensor Classification, Units of Measurements, Sensor Characteristics

Unit 2: Physical Principles of Sensing (08)
Electric Charges, Fields, and Potentials, Capacitance, Magnetism, Induction, Resistance, Piezoelectric Effect, Hall Effect, Temperature and Thermal Properties of Material, Heat Transfer, Light, Dynamic Models of Sensor Elements

Unit 3 : Interface Electronic Circuits (10)
Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

Section II

Unit 4: Sensors in Different Application Area (09)
Occupancy and Motion Detectors, Position, Displacement, and Level, Velocity and Acceleration, Force, Strain, and Tactile Sensors, Pressure Sensors, Humidity and Moisture Sensors, Light Detectors, Temperature Sensors

Unit 5 : Sensor Materials and Technologies (08)
Materials, Surface Processing, Nano-Technology

Unit 6 : Actuators (07)
Introduction, Classification, Principle of Operation (Electrical Actuators, Electromagnetic Actuators, Electromechanical Actuators, Hydraulic and Pneumatic Actuators, Micro- and Nanoactuators), Selection Criteria.

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum Ten Practical's and/or assignments based upon above curriculum.

- **Text Books:**

1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer
2. Sensors and Actuators Engineering System Instrumentation By Clarence W de Silva
3. Electrical and Electronic Measurements and instrumentation R.K Rajput S. Chand

- **Reference Books:**

1. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
2. A Course in Electronics and Electrical Measurements and Instruments J.B. Gupta Katson Books
3. A Course in Electrical and Electronic Measurements and Instrumentation A.K.Sawheny Dhanpat Rai

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T. Y. B.Tech (Electronics& Telecommunication Engineering)
Semester-I

SLH32.1: SELF LEARNING MODULE II
COMPUTER ORGANIZATION

Teaching Scheme: **Examination Scheme:**
Self learning, 2 Credits **ESE – 50 Marks**

This course would provide students with an understanding of the design of fundamental blocks used for building a computer system and interfacing techniques of these blocks to achieve different configurations of an entire computer system.

Course Prerequisite:
Student shall have knowledge of Digital Circuits.

Course Objectives:
1. To understand the structure, function & characteristics of computer systems.
2. To understand the design of the various functional units of digital computers.

Course Outcomes:
At the end of this course, Students will be able to,
1. Describe computer architectures.
2. Describe processor structure & its functions.
3. Design micro-programs of a control unit sub-system.
4. Analyze computer memory & IO sub-systems.

Section I

Unit 1: Processor Basic: (08)

CPU organization fundamental, Data representation, Basic formats, Floating point numbers, Instruction sets: Instruction formats, Instruction type, Programming consideration, Introduction to RISC and CISC.

Unit 2: Memory Organization: (07)

Memory Systems, Multilevel memories, Address Translation, Memory allocation schemes FIFO, LRU, OPT, etc. Virtual Memory, Cache memory.

Section II

Unit 3: Control Design: (08)
Introduction, hardwired control design examples, Micro programmed control, Multiplier control unit, CPU control unit design.

Unit 4: System Organization: (07)
Processor programmed I/O architecture, DMA architecture, Interrupt I/O hardware.

- **Text Books:**

1. J.P. Hayes “Computer Architecture and Organization” Third edition, McGraw Hill publication.

- **Reference Books:**

1. Hamacher Zaki “Computer Organization” McGraw Hill publication
2. W. Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India, 2002
3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann,1998

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T. Y. B.Tech (Electronics& Telecommunication Engineering)
Semester-II

SLH32.2: SELF LEARNING MODULE II
RENEWABLE ENERGY SYSTEMS

Teaching Scheme: **Examination Scheme:**
Self learning, 2 Credits **ESE –50 Marks**

This course introduces importance of renewable energy, its need and generation.

Course Prerequisite:
Student shall have knowledge different types of energy resources

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Course Objectives:
1. To study energy generation, different energy sources and impact on environment
2. To gain knowledge of solar radiation and its application
3. To understand wind energy and its nature
4. To understand ocean and geothermal energy

Course Outcomes:
At the end of this course, Students will be able to,
1. Student can describe energy reserves of India and different energy sources
2. Student can measure solar radiation parameters and performance
3. Student will be able to calculate different parameters of wind turbines
4. Student can implicit the importance and application of geothermal and ocean energy

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Section I

Unit 1: Energy Resources and Utilization: (05)
Conservation and forms of energy, energy reserves in India, nuclear power, hydroelectric power potential, India's power scene, impact on environment, renewable energy sources, energy parameters, cogeneration, rational use of energy, energy efficiency and conservation, distributed energy systems and dispersed generation.

Unit 2 : Solar Radiations and its measurements (05)
Solar constant, spectral distribution of extraterrestrial radiation, terrestrial solar radiation, solar radiation geometry, computation of COSθ, sunrise, sunset, day length, LAT, Solar Thermal energy collectors, design parameters, laws of thermal radiation, radiation heat transfer between real bodies, radiation optics, transmitivity, heat losses and coefficient, Solar Thermal energy storage.

Unit 3 : Solar photovoltaic systems& Solar Applications (05)

Solar photovoltaic systems: Photovoltaic, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells, Design of PV array, Efficiency and cost of PV systems

Solar Applications: Solar water heating, solar pumping system, solar cooker, solar green house.

Section II

Unit 4 : Wind energy (05)

Classification, types of rotors, terminology, operation of wind turbines, wind energy extraction, wind characteristics, wind speed, energy estimation, power density duration curve, density function, field data analysis, direction and wind speed, variation of wind speed, wind scale, energy pattern factor in wind power studies, advantages and disadvantages, wind energy farms.

Unit 5 : Ocean and Geothermal Energy (05)

Ocean Energy: Tidal Energy, Tidal characteristics, Tidal Energy estimation, Development of a tidal power scheme, Wave energy- characteristics-energy and power from the waves.

Unit 6 : Geothermal energy (05)

Structure of earth's interior, sites, field, gradient, resources, power generation, geothermal resources in India, utilization, global status of electricity generation from geothermal resources, advantages of geothermal energy

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- **Text Books:**

1. D.P. Kothari, K.C. Singal and Rakesh Ranjan, ―Renewable Energy Sources and Emerging Technologies‖, Prentice Hall of India, New Delhi, 2009.
2. S.P. Sukhatme, ―Solar Energy: Principles of Thermal Collection and Storage‖, TMH, New Delhi, 2008

- **Reference Books:**

1. Chetan Singh Solanki, ―Renewable Energy Technologies‖, Prentice Hall of India, New Delhi, 2009
2. G. D. Rai, ―Non- conventional Energy Sources‖, Khanna publishers, New Delhi, 2011.
3. Malti Goel, ―Energy Souces and Global Warming‖, allied publishers Pvt Ltd. New Delhi,2005.

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Semester-II

SLH32.3: SOFT COMPUTING

Teaching Scheme: **Examination Scheme:**

Self learning, 2 Credits **ESE –50 Marks**

This course introduces principle components like fuzzy logic, neural networks and genetic algorithm, which have their roots in Artificial Intelligence.

Course Prerequisite:

1. A strong mathematical background.
2. Proficiency with algorithms.
3. Critical thinking and problem solving skills.

Course Objectives:

1. To make student understand basics of fuzzy logic.
2. To introduce to student basics of neural networks.
3. To make student understand fuzzy logic and neural networks, which have their roots in Artificial Intelligence.
4. To design Intelligent controllers such fuzzy controller, neuro controller and evolutionary controllers

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Course Outcomes:

1. Student can identify and describe soft computing techniques and their roles in building intelligent machines.
2. Student can apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
3. Student can apply neural networks to pattern classification.
4. Student is able to use existing software tools to solve real problems using a soft computing approach.

Section I

Unit1: Introduction to Soft Computing (05)

Introduction to Soft Computing, Concept of computing systems., "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

Unit 2: Fuzzy logic (05)

Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences.

Unit 3: Fuzzy Systems (05)
Development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Fuzzy logic controller design., Some applications of Fuzzy logic.

SECTION-II

Unit 4: Introduction to Neural Networks (05)
Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Unit 5: Artificial Neural Networks (05)
Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

Unit 6: Single Layer Feed Forward and Multilayer Feed forward Neural Networks (05)
Single Layer Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.
Multilayer Feed forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Kolmogorov Theorem, Learning Difficulties and Improvements.

- **Text Books:**
  1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajase kharan and Rai – PHI Publication.
  2. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
  3. Neural Networks and Learning Machines Simon Haykin (PHI)\

- **Reference Books:**
  1. Neural Engineering by C.Eliasmith and CH. Anderson, PHI
  2. Neural Networks – Simon Hakins , Pearson Education
  3. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
  4. George J.Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic”, PHI, New Delhi, 2004.

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Semester-II

ET326: MINI HARDWARE PROJECT

Teaching Scheme:	**Examination Scheme:**
Practical – 2 Hours/week, 1 Credit	**ICA –50 Marks**

This course is introduced to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The Project work may be beyond the scope of curriculum of courses for learning additional skills, developing the ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning.

Course Prerequisite:
Student shall have knowledge of PCB designing, circuit designing, testing, soldering.

Course Objectives:
1. To produce PCB artwork using an appropriate EDA tool.
2. To practice good soldering, testing, fault detection and effective trouble-shooting.
3. To design and implement application based hardware project.
4. To present technical seminar and display the project.

Course Outcomes:
At the end of this course, Students will be able to,
1. Produce PCB artwork using an appropriate EDA tool.
2. Practice good soldering, testing, fault detection and effective trouble-shooting.
3. Design and implement application based hardware project.
4. Present technical seminar and display the project.

- **Guidelines for project implementation:**

1) Project group should be not more than 3 students per group.
2) Domains for projects may be based on a particular application from the following, but not limited to:

   i. Instrumentation and Control Systems
   ii. Electronic Communication Systems
   iii. Biomedical Electronics
   iv. Power Electronics
   v. Audio, Video Systems

vi. Embedded Systems

vii. Mechatronics Systems

3) Week 1 & 2: Formation of groups, searching of an application based hardware project

4) Week 3 & 4: Finalization of Mini project & Distribution of work.

5) Week 5 & 6: PCB artwork design using an appropriate EDA tool & Simulation.

6) Week 7 & 8: Procurement of electronic components for the project & PCB manufacturing.

7) Week 9, 10 & 11: Hardware assembly, testing, fabrication

8) Week 12: Demo, Group presentation & report submission

- **Internal Continuous Assessment (ICA):**

1. The seminar shall consist of the Literature Survey, Market survey, Basic project work and applications of Mini project.
2. Seminar Assessment shall be based on Innovative Idea, Presentation skill, depth of understanding, Applications, Future Scope and Individual Contribution.
3. A certified copy of seminar/ project report shall be required to be presented at the time of final submission.

- **Text Books:**

1. Thomas C Hayes, Paul Horowitz, ―The Art of Electronics, Newens Publication
2. Jim Williams (Editor) ― Analog Circuit Design: Art, Science and Personalities, EDN series for Design Engineers
3. M Ashraf Rizvi ― Effective Technical Communication, Tata McGraw Hill Education Pvt. Ltd.

- **Reference Books:**

1. Robert Boylested, ― Essentials of Circuit Analysis‖, PHI Publications
2. Meenakshi Raman, Sangeeta Sharma ― Technical Communication, Principles and Practice, Oxford University Press
3. A.E. Ward, Angus ― Electronic Product Design, Stanley thornes Publishers, UK.
4. C Muralikrishna, Sunita Mishra, ― Communication Skills for Engineers, Pearson