

**NOTIFICATION**

No. 136 /2021

Date : 02/12/2021

**Subject :- Implementation of new syllabi of Semester V & VI of B.E. (Electronics & Telecommunication Engg.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum from the session 2021-2022 & onwards.**

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new syllabus of V & VI of B.E. in Electronics & Telecommunication Engineering (C.B.C.S.) as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2021-2022 and onwards in phase wise manner as per **Appendix – A** :

Sd/-  
(Dr.T.R.Deshmukh)  
Registrar  
Sant Gadge Baba Amravati University

**Appendix – A**

**SYLLABUS PRESCRIBED FOR B.E. SEMESTER V & VI (ELECTRONICS & TELECOMMUNICATION ENGG.)**

**5ETC01: MICROCONTROLLER**

**Course Pre-Requisite:**

3ETC03: Digital System Design

**Course Objectives:**

1. To study fundamentals of microprocessor systems
2. To deal with interfacing of different peripheral devices with Microprocessor
3. To study fundamentals of microcontroller systems with Assembly Language Programming
4. To understand microcontroller C Language Programming concepts.
5. To know the importance of different peripheral devices and their interfacing to microcontrollers
6. To get familiar with RISC Architecture

**Course Outcomes:**

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

1. Attain the knowledge of Microprocessor 8085
2. Understand the Interfacing of various peripheral devices with Microprocessor 8085
3. Attain the knowledge of Microcontroller 8051
4. Understand assembly language & C Programming for Microcontrollers
5. Understand the Interfacing of various peripheral devices with Microcontroller 8051
6. Gain knowledge of advance Microcontrollers

	<b>Subject: MICROCONTROLLER</b>	L
	<b>Introduction to Microprocessor</b>	
<b>Unit-1</b>	8085: Pin Diagram and Architecture, Addressing Modes, Instruction Set, Stack & Subroutine, Interrupt system, Data transfer schemes	8
	<b>I/O Interfacing of 8085</b>	
<b>Unit-2</b>	Address space partitioning schemes, Architecture and interfacing of: PPI 8255, PIT 8254, USART 8251.	8
	<b>Introduction to Microcontroller 8051</b>	
<b>Unit-3</b>	Architecture, Signal description, Memory organization, Interrupt structure, Timers and its modes, Addressing Modes, Instruction set, Assembly Language Programming, Serial communication modes	9
	<b>8051 Programming in C :</b>	
<b>Unit-4</b>	Data types, IO programming, Logic operations, Data conversion programs, Accessing code ROM space, Data serialization.	8
	<b>Interfacing and Programming using C with 8051:</b>	
<b>Unit-5</b>	LED, LCD display, Keyboard, Stepper Motor, DC motor, Relays, ADC 0808, DAC 0809	8
	<b>Introduction to RISC Processors:</b>	
<b>Unit-6</b>	RISC Features, Difference between CISC and RISC, 32 bit ARM7 Philips NXP LPC2148 Microcontroller : Architecture, Registers, Pipeline	7
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Gaonkar R.S: Microprocessor Architecture Programming and Applications with the 8085, Penram International Pub.
2. M. A. Mazidi, J. G. Mazidi and R. D. McKinley : The 8051 Microcontroller and Embedded Systems using Assembly and C, Pearson Education (2nd Ed.)
3. Furber: ARM System on Chip Architecture, 2<sup>nd</sup> Edition, Person India

**References:**

1. K. J. Ayala : The 8051 Microcontroller, Penram Int. Pubs., 1996
2. Phillips NXP LPC 2148 User Manual.
3. Data Sheet Manual by INTEL

**5ETC02: CONTROL SYSTEM**

**Course Pre-Requisite:**

1. (IA1) Engineering Mathematics-I
2. (IB1) Engineering Mathematics-II
3. (4ETC3) Signals and Systems

**Course Objectives:**

1. To understand the fundamental concepts of Control systems and mathematical modeling of the physical systems.
2. To analyze time response of the LTI system.
3. To analyze LTI system using frequency response.
4. To develop and analyze State Variables of the system.

**Course Outcomes:**

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

1. Understand mathematical models of electrical, mechanical and electromechanical systems.
2. Determine transfer functions from block diagrams and signal flow graph.
3. Evaluate transient response and steady state response parameters.
4. Analyze stability of the LTI system using Routh criterion and root locus
5. Analyze stability of the LTI system using bode plot and Nyquist criterion
6. Create the state model and Evaluate response of the system using state variable method.

	<b>Subject: CONTROL SYSTEM</b>	L
	<b>Basics of Control system</b>	
<b>Unit-1</b>	Types of control systems Classification of control system, Mathematical modeling of Physical Systems, Electrical Analogous Systems, Force -voltage analogy, force- Current analogy.	5
	<b>Control system Representation</b>	
<b>Unit-2</b>	Block diagram reduction technique, rules for block diagram reduction. Analysis of multiple input multiple output systems, properties of signal flow graphs, Mason's gain formula basic control actions.	6
	<b>Time Response Analysis:</b>	
<b>Unit-3</b>	Standard test signals, Time response of first order and second order system, impulse response function, Transient domain specifications, Steady state analysis: steady state error and error constants, dynamic error coefficients	6
	<b>Stability of Control System:</b>	
<b>Unit-4</b>	Concept of stability, necessary conditions for stability, Routh stability criterion. Root locus Techniques: Introduction, Construction of root locus, construction rules, Stability analysis of systems using root locus, Effect of addition of open loop zeros & poles.	7
	<b>Frequency- Domain analysis:</b>	
<b>Unit-5</b>	Introduction, correlation between time and frequency response, Bode plot: general procedure for construction, Gain margin and phase margin, Stability analysis of systems using Bode plots. Polar plots, Nyquist stability criterion.	6
	<b>State Variable Analysis:</b>	
<b>Unit-6</b>	Space model representation of LTI systems using physical, phase and canonical variables, Relationship between state variable model and transfer function, state transition matrix and its computation, Solution of state equations. Controllability and Observability.	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Nagrath I. J. and M. Gopal, "Control Systems Engineering", 5th Ed. New Age International.
2. K. Ogata: Modern Control Engineering, Fourth Edition (PHI)

**References:**

1. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Ed., Pearson Education.
2. M. Gopal, "Control System Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
3. Norman S. Nise, "Control System Engineering", 5th Edition, Wiley.
4. Bhattacharya: Control System Engineering, 2nd Edition (Pearson Education).
5. Benjamin C. Kuo, Automatic Control System "JOHN WILEY & SONS, INC. 9th Edition.
- 6.

**5ETC03: DIGITAL SIGNAL PROCESSING**

**Course Pre-Requisite:**

1. 3ETC01 Engineering Mathematics-III
2. 4ETC04 Signals and Systems

**Course Objectives:**

1. Learn discrete signal and system fundamentals.
2. Learn the discrete-time signals in the frequency domain, using Z-transform and DFT.
3. Understand the implementation of the DFT in terms of the FFT
4. Learn the basic forms and design of FIR and IIR filters.
5. Learn the application filter bank in multirate DSP.
6. Become aware of some applications of digital signal processing.

**Course Outcomes:**

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

1. Manipulate the discrete-time signals and identify the type system.
2. Compute the Z-transform of a sequence, identify its region of convergence and compute the inverse Z-transform.
3. Evaluate the Fourier transform of a signal.
4. Design FIR and IIR filters.
5. Understand the concepts of Multirate Digital Signal Processing and need of Filter banks.
6. Understand the application of Digital Signal Processing

	<b>Subject: DIGITAL SIGNAL PROCESSING</b>	L
	<b>Introduction to Discrete Time Signals [DTS]:</b>	
<b>Unit-1</b>	Discrete Time Signal, representations of DTS, Basic Signal Operations, Linear Convolution by using Analytical and Graphical Method.	6
	<b>Z-Transform:</b>	
<b>Unit-2</b>	Definition and Properties of Z-Transform, Concept of Region of Convergence [ROC], Inverse Z-transform using long division method, PFE method and residue method.	6
	<b>Discrete and Fast Fourier Transform:</b>	
<b>Unit-3</b>	Definition and Properties of DFT, IDFT. Circular convolution of sequences using DFT and IDFT. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT. [Numerical based on DIT-FFT & DIF-FFT ]	6
	<b>Finite Impulse Response (FIR) filters:</b>	
<b>Unit-4</b>	Design techniques for FIR filter by windowing method: Rectangular window. Realization of basic structure FIR system: Direct form and Cascade.	5
	<b>Infinite Impulse Response (IIR) filters:</b>	
<b>Unit-5</b>	IIR Filter Design by Mapping of S-plane to Z-plane: impulse invariance method, bilinear transformation method. Realization of basic structure IIR system: Direct form-I, Direct Form-II, Cascade & Parallel.	6
	<b>Multirate Digital Signal Processing:</b>	
<b>Unit-6</b>	Sampling, Sampling rate conversion, multi-level filter bank. Overview and architecture of DSP processor TMS320C54XX. Applications of DSP (Only Block Diagram): Speech Signal, RADAR & SONAR.	7
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Nagoorkani, Digital Signal Processing, Tata McGraw-Hill Education, Second Edition.
2. S. Salivahanan, A. Vallavaraj, Digital Signal Processing, Tata McGraw-Hill Education, 2001.

**References:**

1. Oppenheim & Schaffer, Discrete Time Processing, PHI.
2. Proakis & Manolakis D.G., Digital Signal Processing, PHI.
3. Mitra S.K., Digital Signal Processing, TMH.
4. Roman Kuc, Digital Signal Processing, MGH.
5. Ifeather E.C., Jervis B.W., Digital Signal Processing, Addison Wesley.
6. P.P. Vaidyanathan, DSP and Multirate Systems, PHI.

**5ETC04 Professional Elective - I (PE-I): (i) POWER ELECTRONICS**

**Course Pre-Requisite:**

1. 1B3 Basic Electrical Engineering.
2. 3ETC02 Electronic Devices and Circuits.

**Course Objectives:**

1. To introduce power electronics devices; SCR, TRIAC, IGBT, MOSFET and to learn their characteristics.
2. To develop the ability to analyze the dynamics in power electronic converters/drives systems.
3. To study AC-DC converters and effect of freewheeling diode.
4. To study AC-AC, DC-AC, DC-DC converters.
5. To build and test circuits using power devices such as SCR
6. To study applications of power converters in DC drives.

**Course Outcomes:**

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

1. Analyze the characteristics of various power electronics devices .
2. Understand SCR firing circuits, commutation techniques.
3. Analyze and design controlled rectifiers and dual converters
4. Analyze and design DC to DC, AC to AC converters and DC to AC inverters,
5. Design and develop power electronic circuits for various applications.
6. Know various applications of power converters in DC drives.

	<b>Subject: POWER ELECTRONICS</b>	L
<b>Unit-1</b>	SCR -construction, characteristics, two transistor analogy for turning ON-OFF a SCR, different methods of turning ON of a SCR, turn OFF mechanism, Thyristor firing circuit using UJT, Protection of SCR (snubber circuit)	6
<b>Unit-2</b>	Triac, Diac-construction, characteristics. power transistor, power MOSFET, IGBT - their construction & characteristics, Introduction to GTO, Classification of circuit for forced commutation.	7
<b>Unit-3</b>	Principle of phase control, single phase half wave controlled rectifier, half controlled bridge & fully controlled bridge rectifier for resistive and RL load, derivation for output voltage and current, effect of freewheeling diode, single phase dual converters.	6
<b>Unit-4</b>	Series inverter, improved series inverter, parallel inverter, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase transistorized bridge inverter.	6
<b>Unit-5</b>	Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper circuit, Jones chopper, step-up chopper, step up/down chopper and AC chopper.	6
<b>Unit-6</b>	Basic principle of cyclo-converter, single phase to single phase cyclo-converter. speed control of DC series motors speed control of DC shunt motor using phase controlled rectifiers UPS, fan speed regulator	5
<b>Total</b>		<b>36</b>

**Text Books:**

1. M.D.Singh, K.B. Khanchandani, "Power Electronics", Tata McGraw-Hill.
2. Muhammad H. Rashid, "Power electronics" Prentice Hall of India.

**References:**

1. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
2. P.C. Sen., "Modern Power Electronics", edition II, Chand & Co.
3. V.R.Moorthi, "Power Electronics", Oxford University Press.
4. Cyril W., Lander, "Power Electronics", edition III, McGraw Hill.
5. G K Dubey, S R Doradla, "Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

**5ETC04 Prof. Elective –I (ii) FIBER OPTICS COMMUNICATION**

**Course Objectives:**

1. To understand the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To impart the knowledge of different kind of losses, signal distortion and dispersion in optical fiber.
3. To elaborate the various aspects of optical sources.
4. To discuss principles of fiber optical receivers and detectors.
5. To understand the concept of optical fiber couplers and switches.
6. To introduce to WDM and DWDM systems and effects on fiber link.

**Course Outcomes:**

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

1. Illustrate the principles fiber-optic communication, the components and Losses and dispersion in fiber.
2. Explain the transmission characteristics of optical fiber
3. Express the properties of the optical components in sources.
4. Explain operation of lasers, LEDs, and detectors in fiber
5. Describe the aspects of optical fiber coupler and switches
6. Elaborate WDM and DWDM systems.

**SYLLABUS**

**Unit I: Optical Fiber Communication System:**

Basic optical laws and definitions, Optical fiber modes and configurations, N.A. Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Block Diagram of fiber optic communication [Numerical based on N.A.].  
(6 Hours)

**Unit-II: Types of fiber and Dispersion:**

Attenuation: Units, absorption, scattering losses radioactive losses, core and cladding losses, Material dispersion, wave guide dispersion, intermodal dispersion. [Numerical based on mode calculations] (6 Hours)

**Unit-III: Optical Sources:**

Light Emitting Diodes: Structure, Light source materials. Laser Diodes: Structure, threshold conditions, Modulations of laser diodes. (Numerical based on efficiency) (6 Hours)

**Unit-IV: Optical Detectors:** Principles of photodiodes, Photo detector noise, Detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain. (Numerical based on response time, avalanche gain)  
(6 Hours)

**Unit-V: Optical switches:**

Introduction to Fiber Couplers: Three & four port coupler, Star coupler, electro-optic-switches. Optical amplifiers - EDFA, Raman amplifier (6 Hours)

**Unit-VI: WDM and DWDM systems:**

Need of WDM, Principles of WDM networks, Nonlinear effects in fiber optic links, Concept of self-phase modulation, Introduction to DWDM. (6 Hours)

**Text Book:** G. Keiser, "Optical Fibre Communication", McGraw Hill International.

**Reference Book:** Seniors J. M., "Optical Fibre Communication and Applications", Prentice Hall of India Pvt. Ltd., New Delhi.

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**Text Book:** G. Keiser, *Optical Fibre Communication*, McGraw Hill International.

**Reference:**

1. Seniors J. M., *Optical Fibre Communication and Applications*, Prentice Hall of India Pvt. Ltd., New Delhi

**5ETC04 Professional Elective - I (PE-I): (iii) SPEECH AND AUDIO PROCESSING**

**Course Pre-Requisite:**

1. 3ETC01 Engineering Mathematics-III
2. 4ETC04 Signals and Systems
3. 4ETC01 Analog and Digital Communication

**Course Objectives:**

1. To be able to relate human physiology and anatomy with signal processing paradigms.
2. To acquire the knowledge of speech generation and speech recognition models.
3. To understand methods/techniques used in speech signal estimation & detection.

**Course Outcomes:**

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

1. Illustrate how the speech production is modeled
2. Summarize the techniques involved in collecting the features from the speech signal in time and frequency domain.
3. Summarize the various speech coding techniques.
4. Understand the process Speech Synthesis.
5. Apply techniques/methods used for speech enhancement.
6. Apply techniques/methods used for speech recognition.

**Subject: SPEECH AND AUDIO PROCESSING**

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<b>Unit-1</b>	<p><b>Speech Production and Acoustic Phonetics:</b> Process of speech production, Articulatory phonetics, Acoustic Phonetics, Acoustic theory of speech production, Co- articulation, Prosody, Digital models of speech signals, Brief applications of speech &amp; audio processing</p>	6
<b>Unit-2</b>	<p><b>Speech Analysis:</b> Time and frequency domain methods for analysis of speech: Methods for extracting energy ,average magnitude, zero crossing rate, silence discrimination using ZCR and energy, short time Fourier analysis, Formant extraction, Pitch extraction, Cepstral analysis.</p>	6
<b>Unit-3</b>	<p><b>Coding of Speech Signals:</b> Introduction, Quantization, Speech redundancies, Time domain waveform coding, Linear predictive coding: Linear Delta Modulation ,Adaptive Delta Modulation, Adaptive Differential Pulse Code Modulation</p>	6
<b>Unit-4</b>	<p><b>Speech Synthesis:</b> Principles of speech synthesis, Articulatory synthesis, Formant synthesis and LPC synthesis.</p>	6
<b>Unit-5</b>	<p><b>Speech Enhancement:</b> Introduction, Nature of interfering sounds, speech enhancement techniques: spectral subtraction and filtering, harmonic filtering, Spectral subtraction, Adaptive noise cancellation</p>	6
<b>Unit-6</b>	<p><b>Speech Recognition:</b> Introduction, Baye's rule, Segmental feature extraction, MFCC, DTW, HMM approaches for speech recognition</p>	6

**Total      36**

**Text Books:**

1. "Speech Communications: Human & Machine", Douglas O'Shaughnessy, Universities Press.
2. "Digital Processing of Speech Signals", Rabiner and Schafer, Prentice Hall, 1978.

**References:**

1. "Discrete-Time Speech Signal Processing: Principles and Practice", Thomas F. Quatieri, Publisher: Prentice Hall.
2. "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Nelson Morgan and Ben Gold, John Wiley & Sons.
3. "Speech Analysis Synthesis and Perception", J. L. Flanagan, Second edition, Springer-Verlag(1972).
4. "Speech and Audio Signal Processing", Gold & Morgan, 1999, Wiley and Sons.

**5ETC05 Open Elective - I (OE-I): (i) SENSORS AND TRANSDUCERS**

**Course Pre-Requisite:**

1. 1B3 Basic Electrical Engineering.
2. 3ETC02 Electronic Devices and Circuits.

**Course Objectives:**

1. To provide a basic knowledge about Sensors and transducers.
2. To learn about the various sensor and transducer for measurement of physical quantities.

**Course Outcomes:**

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

1. Understand the basic aspect of transducers and sensors
2. Gain knowledge of statistical characteristic and Errors of system.
3. Realize the fundamental concept about temperature and Velocity measurement
4. Acquire knowledge of measurement of displacement and Humidity.
5. Familiarize the basic information about measurement of Pressure, Flow, Level
6. Aware about the basics of Strain gauge and smart sensors

	<b>Subject: SENSORS AND TRANSDUCERS</b>	L
	<b>Sensor &amp; Transducers:</b>	
<b>Unit-1</b>	Definition, Types & selection of sensors, Need of sensor, Difference between Sensors & Transducers, Classification of Transducer, Selection criteria. Introduction to Generalized Instrumentation system with example.	6
	<b>Characteristic, parameters and Errors</b>	
<b>Unit-2</b>	Characteristics of instruments ó static characteristics, Statistical Parameters with numericals. Error and its Types: Gross error, Systematic Error, Random Error with remedies.	6
	<b>Temperature Measurement:</b>	
<b>Unit-3</b>	Introduction to Thermistor, RTD, Thermocouple and LM 335, Total Radiation Pyrometer	6
	<b>Velocity Measurement:</b>	
	Velocity measurement system by encoder, Magnetic Pickup and Photo detector (Linear and Angular Measurement)	
	<b>Measurement of Displacement:</b>	
<b>Unit-4</b>	Resistive, Inductive (LVDT), Capacitive Methods	6
	<b>Humidity Measurement:</b>	
	Resistive, Capacitive, Piezoelectric, and Infrared	
	<b>Measurement of Pressure:</b> Primary pressure sensors - elastic elements like bourdon tube and diaphragm Electrical/Secondary Pressure Transducers: Capacitive, piezo-electric and its material, Low Pressure (Vacuum): Pirani gauge.	
<b>Unit-5</b>	<b>Measurement of Flow:</b> Hot wire anemometer	6
	<b>Measurement of Level:</b> Resistive method, Ultrasonic level detector	
	<b>Strain Measurement:</b> Introduction, types of strain gauge, gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensation and applications of strain gauges.	
<b>Unit-6</b>	<b>Introduction to smart sensors:</b> Objective, block diagram, advantages and disadvantages.	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Sawney A K and Puneet Sawney, "A Course in mechanical measurements and instrumentation and control", 12th edition, Dhanpat Rai and Co, new delhi, 2013.
2. "Electronics instrumentation" by H. S. Kalsi [TMH]

**References:**

1. David A. Bell, Electronic Instrumentation and Measurements, Third Edition, Oxford Higher Education
2. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.
4. Ernest O.Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.

**5ETC05 Open Elective - I (OE-I): (ii) DATA STRUCTURE**

**Course Pre-Requisite:**

1. 3ETC05 Object Oriented Programming

**Course Objectives:**

To impart the concepts of data structures and algorithms.

**Course Outcomes:**

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

1. Able to understand basics and applications of different linear and nonlinear data structures
2. Able to design and implement various data structure algorithms and analyze the efficiency of an algorithm.
3. Able to understand Linked List and implement algorithm.
4. Able to understand the working principle and Implementation of stacks and queues.
5. Able to implement learn Trees, Graph and their applications
6. Able to write an algorithm on different sorting methods and analyze the complexities of algorithms.

	<b>Subject: DATA STRUCTURE</b>	L
	<b>Introduction and Overview</b>	
<b>Unit-1</b>	Basic Terminologies: Elementary Data Organizations, Introduction to Linear Array, Types and Representation in Memory, Data Structure Operations, Algorithms: Complexity, Time-Space Tradeoff, Searching Methods: Linear Search and Binary Search Techniques and their Complexity Analysis..	6
<b>Unit-2</b>	<b>Linked List:</b> Introduction to Linked List, Representation of Linked List in Memory, Traversing a Linked List, Searching a Linked List, Memory Allocation; Garbage Collection, Insertion into a Linked List, Deletion from linked list, Header Linked Lists, Circular Linked Lists, Two-Way Lists (Doubly linked list) and Operations.	6
<b>Unit-3</b>	<b>Stacks, Queues and Its Applications:</b> Introduction to Stack, Array and Linked List Representation of Stack, Applications of Stacks: Arithmetic Expressions: Polish Notation, Recursion, Tower of Hanoi Problem, Queues: Linked Representation of Queues, Circular queue, Deques, Priority Queues.	6
<b>Unit-4</b>	<b>Tree</b> Basic Tree Terminologies and Representing Binary Trees in Memory, Traversing Binary Trees, Header Nodes; Threads, Threaded Binary Trees, Binary Search Trees, Searching and Inserting in Binary Search Trees, Deleting in a Binary Search Tree, Balanced Binary Trees, AVL Search Trees, Heap and Heapsort, Pathlengths; Huffman's Algorithm. General trees.	6
<b>Unit-5</b>	<b>Graph and Their Applications</b> Introduction, Graph Theory Terminology, Sequential Representation of Graphs; Adjacency Matrix; Path Matrix, Warshall's Algorithm; Shortest Paths, Linked Representation of Graph, Traversal algorithms, Operations on Graph, BFS, DFS, Spanning Trees	6
<b>Unit-6</b>	<b>Sorting And Hashing</b> Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Radix Sort, Performance and Complexity Analysis of various Sorting Methods, Hashing.	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Introduction to data structures with C++ by Seymour Lipschutz.
2. Fundamentals of Data Structures, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

**References:**

1. Algorithms, Data Structures, and Problem Solving with C++, Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. Data Structures through C by Yashwant Kanetkar

**5ETC05 Open Elective - I (OE-I): (iii) INTRODUCTION TO JAVA**

**Course Pre-Requisite:**

1. 3ETC05 Object Oriented Programming.

**Course Objectives:**

1. To Learn basics of programming
2. To understand the foundation of Object-Oriented Programming
3. To learn basic principles of Object-Oriented Programming
4. To study the process of building an application in a modular fashion using Java Programming Language

**Course Outcomes:**

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

1. Fundamentals of Object Oriented Programming and can build & run a basic application at their own
2. Use of selection & repetition statements in Java Program, dealing with methods and playing with classes and objects in real world
3. To create and process single dimensional & multidimensional arrays, to handle strings in Java
4. To create interactive graphical user interface in a desktop application using AWT and/or SWING Components.
5. To handle exceptions and create user defined exception, also learns file handling in Java.
6. To learn concept of multithreading; create, manage threads; and purpose of synchronization.

	<b>Subject: INTRODUCTION TO JAVA</b>	L
<b>Unit-1</b>	<p><b>Java Basics:</b> History of Java, Characteristics of Java, Types of Java Program, an introduction to Classes &amp; Objects, Messages &amp; methods, introduction to Inheritance, Software Engineering &amp; Software Life Cycle, Structure of a java application, Edit-Compile-Run cycle of a java program.</p> <p><b>Java Building Elements:</b> Identifiers, Variables, Constants, Data types, Arithmetic Expressions, Standard Input &amp; Output, Programming Style &amp; Documentation</p> <p><b>Control Structure:</b> Selection Statements- if, if else, Nested if, switch. Repetition Statements- for loop, While loop &amp; do loop, using break &amp; Continue.</p> <p><b>Methods:</b> Creating Methods, Calling a method, Overloading Methods, Concept of Recursion</p>	6
<b>Unit-2</b>	<p><b>OOP:</b> Objects &amp; classes, Passing Objects to methods, Instance Variables &amp; class Variables, Instance Methods &amp; Class Methods, Scope of Variables, Introduction to Packages, the Math Class</p> <p><b>Arrays:</b> Declaring &amp; Creating Arrays, Initializing &amp; Processing Arrays, Array of Objects, Multidimensional arrays.</p> <p><b>Strings:</b> The String Class, The String Buffer Class, The String Tokenizer Class, Command Line Arguments</p>	6
<b>Unit-3</b>	<p><b>Inheritance:</b> Super classes and Subclasses, the super keyword, the <i>this</i> keyword, the Object class, the final and abstract modifiers, the concept of Wrapper Classes, Introduction to Interfaces.</p> <p><b>Graphics Programming:</b> The AWT Class Hierarchy, Frames, Event Driven Programming (Delegation Event Handling Model), Layout Managers, Panels, The Color Class, The repaint(), update() and paint(), Methods, Drawing Lines &amp; different shapes, introduction to adapter classes.</p>	6
<b>Unit-4</b>	<p><b>Creating GUI:</b> Button, Label, Text Field, Text Area, Choice, List, Checkbox, Dialog, Menu, Creating Multiple Windows, introduction to swing components.</p> <p><b>Exception Handling:</b> Exceptions &amp; Exception Types, Understanding Exception Handling, Creating Exception classes, the finally clause.</p>	6
<b>Unit-5</b>	<p><b>File Input &amp; output:</b> File &amp; J File Chooser Objects, Low-Level File I/O, High Level File I/O.</p>	6
<b>Unit-6</b>	<p><b>Multi-Threading:</b> Concept of thread, The Thread class, The Runnable interface, Thread Life cycle, Thread Priority, Thread Groups, concept of synchronization.</p>	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Y. Daniel Liang, "An Introduction to Java Programming" Eastern Economy Edition, PHI
2. C. Thomas Wu, "An Introduction to Object-Oriented Programming JAVA", Fourth Edition, Tata McGraw Hill

**References:**

1. Kathy Sierra & Bert Bates, "Head First Java", O'REILLY
2. E Balagurusamy, "Programming with JAVA, A Primer", Third Edition, TMH

**5ETC06- MICROCONTROLLER- LAB**

É Minimum Eight Experiments based on syllabus of **5ETC01: MICROCONTROLLER** must be conducted.

É Course Objectives and Course Outcomes shall be specified based on the experiments conducted

**5ETC07- DIGITAL SIGNAL PROCESSING LAB**

É Minimum Eight Experiments based on syllabus of **5ETC03: DIGITAL SIGNAL PROCESSING** must be conducted.

É Course Objectives and Course Outcomes shall be specified based on the experiments conducted

**5ETC08- POWER ELECTRONICS LAB**

É Minimum Eight Experiments based on syllabus of **5ETC04: PE(1): (i) POWER ELECTRONICS** must be conducted.

É Course Objectives and Course Outcomes shall be specified based on the experiments conducted

**5ETC09: ELECTRONIC LAB BASED ON INSTRUMENTATION**

**Course Outcomes:**

At the end of this course student will demonstrate the ability to

1. Learn about various Sensors
2. Examine the measurement of various physical quantities using transducers
3. be aware of statistical data analysis of different transducers
4. Understand computerized data acquisition

Minimum Eight Experiments from the list give must be conducted

**List of Experiments:**

1. Temperature measurement using temperature sensor.
2. Measurement of linear displacement using LVDT.
3. Study of instrumentation amplifier
4. Measurement of force using strain gauge
5. Measurement of Pressure using Piezo-electric Transducer.
6. To measure the speed of a motor shaft with the help of non-contact type pick-ups (magnetic or photoelectric).
7. Displacement measurement by Capacitive Transducer
8. Temperature measurement by thermistor.
9. Liquid level measurement using level transducers.
10. Displacement measurement by resistive Transducer.
11. Comparative study of temperature measurement using: RTD, Thermistor and Thermocouple.
12. Study of Smart Sensors and Data Acquisition Systems

**Note:**

An orientation program of 15 hours duration / MOOC to be offered to the students during

- (a) V<sup>th</sup> semester : Indian Constitution
- (b) VI<sup>th</sup> semester : Indian Traditional Knowledge

**B.E. | ELECTRONICS & TELECOMMUNICATION ENGG. (VI SEM)**

**6ETC01 COMMUNICATION NETWORK**

**Course Objectives:**

1. To understand the general principles of network design and compare the different network Topologies.
2. To understand the general principles of switching and various routing algorithms.
3. To acquire the knowledge of functions and protocols of OSI and TCP/IP models.
4. To understand Application layer Protocols.

**Course Outcomes:**

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

1. Identify different types of network devices and their functions within a network.
2. Understand the basic functions of data logical link control and media access control and protocol used in this layers.
3. Distinguish between the layers of the OSI and TCP/IP model.
4. Analyze, specify and design routing strategies for an IP based networking infrastructure
5. Understand the concept of reliable and unreliable transfer protocol of data and how TCP and UDP implement these concepts.
6. Understand various Application layer Protocols.

	<b>Subject: 6ETC01 COMMUNICATION NETWORK</b>	L
<b>Unit-1</b>	<b>Data Communication Network:</b> A brief history of Internet, Protocols and Standards, Standard Organizations, Need for Protocol Architecture, OSI Reference Model, Overview of TCP/IP architecture, Addresses in TCP/IP.	8
	<b>Types of Network:</b> LAN, MAN, WAN. Network connecting Devices: Hubs, Repeater, Bridges, Switches, Routers, Gateways. <b>Network Topology:</b> Mesh, Bus, Tree, Ring, Star.	
<b>Unit-2</b>	<b>Data Link Control Protocols:</b> Need for Flow control, Stop and Wait Flow Control, Sliding Window Flow Control, Stop and wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, Transmission efficiency of ARQ protocols.	6
<b>Unit-3</b>	<b>Multiple Access Control Protocols:</b> Random Access Techniques: ALOHA, Slotted ALOHA, Contention Techniques: CSMA, CSMA/ CD (IEEE 802.3), CSMA/CA. Controlled Access Techniques: Polling, Token Passing. <b>Medium Access Control Protocols:</b> Token Bus (IEEE 802.4), Token Ring (IEEE 802.5).	6
<b>Unit-4</b>	<b>Network layer:</b> TCP IP Reference Model, IPv4-Classful and Classless Addressing, Virtual circuit and Datagram networks, Router, Routing algorithms, Dijkstra's Algorithm (Problems expected), Bellman Ford Algorithm (Problems expected). Traffic Control: Leaky bucket algorithm, Token bucket algorithm.	5
<b>Unit-5</b>	<b>Transport layer:</b> Connectionless transport - UDP, Connection-oriented transport ó TCP, Remote Procedure Call. <b>Congestion Control and Resource Allocation:</b> Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.	5
<b>Unit-6</b>	<b>Application Layer:</b> Domain Name Space (DNS), TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP.	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. B. Forouzan, óData Communications and Networkingö, 4th Edition, McGraw-Hill.
2. Andrew S. Tanenbaum and David J. Wetherall, óComputer Networksö, 5th Edition, Pearson Education, Inc.
3. William Stallings, óData and Computer Communicationö, 8th Edition, Pearson Education, Inc.

**References:**

1. James F. Kuross, Keith W. Ross, "Computer Networking A Top-Down Approach Featuring the Internet", Third Edition, Addison Wesley, 2004.
2. Nader F. Mir, "Computer and Communication Networks", Pearson Education, 2007.
3. Comer, "Computer Networks and Internets with Internet Applications", Fourth Edition, Pearson Education, 2003.

**6ETC02: COMPUTER ARCHITECTURE**

**Course Pre-Requisite:**

1. 3ETC03 Digital System Design
2. 5ETC01 Microcontroller

**Course Objectives:**

1. To familiarize the basic concepts and structure of computers
2. To understand different types of instruction formats and concepts of arithmetic operations
3. To learn the concepts of microinstruction, its sequencing and execution.
4. To learn different types of memories and understand memory organization
5. To learn how I/O devices are organised and accessed.
6. To understand the concept of parallel processing and multi-processor architecture.

**Course Outcomes:**

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

1. Learn how computers work
2. Analyse the performance of computers
3. Perform floating point arithmetic operations and design ALU as per the requirement
4. Know how computers are designed & built
5. Understand and design different types of memory systems
6. Understand issues affecting recent processors

	<b>Subject: 6ETC02: COMPUTER ARCHITECTURE</b>	L
<b>Unit-1</b>	<b>Basic Structure of Computers:</b> Hardware & software Functional units, Basic operational concepts, Bus structures, addressing methods and Machine program sequencing: Memory locations, Addresses, Instruction and Instruction sequencing, Addressing modes, Basic I/O operations.	8
<b>Unit-2</b>	<b>Processing Unit:</b> Processor organization, information representation, number formats, Instruction sets and its implementation. Arithmetic operation, ALU design, Floating point arithmetic, IEEE 754 floating point formats.	6
<b>Unit-3</b>	<b>Control Unit:</b> Micro operation, control of processor Hardwired implementation, micro program control: Concepts, microinstructions sequencing and execution, application of microprogramming.	6
<b>Unit-4</b>	<b>Memory Unit :</b> Concept of virtual memory, Memory hierarchies, Main memory allocation, Replacement policies, segments and pages, file organization, High speed memory, inter-board memories, Cache memories, Associative memories.	5
<b>Unit-5</b>	<b>I/O Organization :</b> Accessing I/O devices, Interrupts, Enabling and disabling interrupts, handling multiple devices, DMA, I/O Hardware, Standard I/O interfaces.	5
<b>Unit-6</b>	<b>Parallel Processing:</b> Basic concepts, types of parallel processors. Pipeline processor: Pipeline types, design, structures, Multiprocessors: Types, performance, parallel programming, Multiprocessor Architecture, interconnect network	6
<b>Total</b>		<b>36</b>

**Text Books:**

1. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition
2. A.S.Tanenbum, "Structured Computer Organization", PHI, Third edition
3. M.M.Mano, "Computer System Architecture", Edition

**References:**

1. V.Carl Hammacher, "Computer Organisation", Fifth Edition
2. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition
3. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition

**6ETC03 PROFESSIONAL ELECTIVE - II (PE-II): (I) CMOS DESIGN**

**Course Pre-Requisite:**

1. 3ETC02 - Electronic Devices & Circuits.
2. 3ETC03 - Digital System Design

**Course Objectives:**

1. To study CMOS transistor theory and performance parameters.
2. To study layout design rules for size & power optimization.
3. To understand the concept of combinational CMOS circuit design.
4. To implement the concept of sequential circuit in CMOS design.
5. To learn the dynamic CMOS logic circuit

**Course Outcomes:**

- Upon successful completion of this course, the student will be able to:
1. To understand the concept of CMOS circuit.
  2. To draw Layout, Stick diagrams of CMOS Circuits.
  3. To analyses the CMOS circuit performance parameter
  4. To implement combinational CMOS circuit design using CMOS logic families.
  5. To design sequential CMOS circuit.
  6. To design the CMOS circuit using dynamic CMOS logic

	<b>Subject: CMOS Design</b>	L
	<b>BCMOS Device Fundamentals:</b>	
<b>Unit-1</b>	Moore's Law, MOS structure capacitance, Channel capacitance, Junction capacitance, Review of MOS transistor models, Non-ideal behaviour of the MOS Transistor. Transistor as a switch, CMOS Inverter and its Characteristics.	8
	<b>VLSI Circuit Design Processes:</b>	
<b>Unit-2</b>	VLSI Design Flow, CMOS Process enhancements (Interconnect, Circuit Elements, CMOS Lambda-based Design Rules, Stick Diagrams, Physical layout of simple CMOS Logic Gates, RC Parasitic, CMOS Fabrication [P-well process, N-well process]).	6
	<b>CMOS Performance Parameter:</b>	
<b>Unit-3</b>	Introduction to Delays in CMOS, RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.	6
	<b>Combinational Circuit Design:</b>	
<b>Unit-4</b>	CMOS logic families, CMOS logic gates design, Complex CMOS circuit, Transmission gate, Pass transistor logic.	5
	<b>Sequential Circuit Design:</b>	
<b>Unit-5</b>	Design of latches and Flip-flops, Static Read - Write Memory (SRAM) Circuits (6T), Dynamic Read-Write Memory (DRAM) Circuits (3T).	5
	<b>CMOS Clocking Styles:</b> CMOS Clocking Styles, Clocks Skew, Clock distribution techniques, Clock Jitter.	
<b>Unit-6</b>	<b>Dynamic Logic Circuit:</b> Dynamic Pass transistor logic, Dynamic CMOS logic, Domino logic, NORA logic.	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, MH, 2002.
2. Neil H. Weste, D. Harris, "Principles of CMOS VLSI design A Circuit & System Perspective", 4th Edition, Pearson (Addison-Wesley), 2011.
3. Wayne Wolfe, "Modern VLSI Design: IP based Approach", 4th Edition, PHI.
4. Jan M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd Edition, Pearson

**References:**

1. S.K. Ghandhi, *VLSI Fabrication Principles*, John Wiley Inc., New York, 1994 (2nd Edition).
2. Plummer, Deal, Griffin, *Silicon VLSI Technology: Fundamentals, Practice & Modeling* PH, 2001.
3. S.M. Sze (Ed), *VLSI Technology*, McGraw Hill.
4. C. Mead and L. Conway, *Introduction to VLSI Systems*, Addison Wesley, 1979.

**6ETC03 PROFESSIONAL ELECTIVE - II (PE-II): (II) SATELLITE COMMUNICATION**

**Course Pre-Requisite:**

1. 3ETC04 Electromagnetic Waves
2. 4ETC01 Analog and Digital Communication

**Course Objectives:**

1. To understand the frequency bands used in satellite communication
2. To know the basics of orbital mechanism, the types of satellite orbits and orbital aspects of Satellite communication.
3. To understand the various typical phenomenon in satellite communication.
4. To understand different satellite channel parameters.
5. To understand the working of different satellite subsystems
6. To understand the various services of satellite.

**Course Outcomes:**

- Upon successful completion of this course, the student will be able to:
- At the end of this course students will demonstrate the ability to
1. Visualize the architecture of satellite systems as a means of high speed, high range communications system.
  2. State various aspects related to satellite system such as orbitalequations, sub-systems in a satellite
  3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.
  4. Learn advanced techniques and regulatory aspects of satellite communication
  5. Understand role of satellite in various applications
  6. Understand VSAT and GPS

	<b>Subject: Satellite Communication</b>	L
<b>Unit-1</b>	<b>Introduction to Satellite Communication:</b> Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication, satellite types ó LEO, MEO, GEO, HEO.	6
<b>Unit-2</b>	<b>Orbital Mechanics:</b> Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity, look angle determination of a satellite, concepts of Solar day and Sidereal day. Geo stationary and non-Geo- stationary orbits.	6
<b>Unit-3</b>	<b>Typical Phenomena in Satellite Communication :</b> Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift, space launch vehicles.	6
<b>Unit-4</b>	<b>Satellite Channels:</b> Electromagnetic field propagation, Atmospheric losses, Receiver noise, Carrier to Noise ratio, Satellite system link model: Uplink, Downlink, Cross link, Transponder, Satellite system parameters, Satellite link analysis, Frequency reuse and depolarization.	6
<b>Unit-5</b>	<b>Satellite sub-systems:</b> Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc. Satellite link budget.	6
<b>Unit-6</b>	<b>Very Small Aperture Satellite (VSAT):</b> Overview of VSAT system, Network architecture, Access control protocols, Signal format, Modulation coding and interference issues, VSAT antennas, Transmitter and Receiver, Link analysis for VSAT network. <b>Satellite Navigation and Global Positioning System (GPS):</b> Radio and Satellite navigation, Position, Location in GPS, GPS receivers and codes, GPS navigation message and signal levels, Timing accuracy, GPS receiver operation, Differential GPS.	6
<b>Total</b>		<b>36</b>

**Text Books:**

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnut: Satellite Communications: Wiley India. 2<sup>nd</sup> Edition, 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009

**Reference:** Dennis Roddy: Satellite Communication: 4<sup>th</sup> Edition, McGraw Hill, 2009

**6ETC03 PROFESSIONAL ELECTIVE - II (PE-II): (III) ADAPTIVE SIGNAL PROCESSING**

**Course Pre-Requisite:**

1. 3ETC01 Engineering Mathematics-III
2. 4ETC04 Signals and Systems
3. 5ETC03 Digital Signal Processing

**Course Objectives:**

1. To introduce with adaptive signal processing and adaptive systems.
2. To be acquainted with desired response, mean square error performance and Wiener Filters.
3. To make familiar with gradient search algorithms and functions.
4. To Understand LMS algorithms and its performance analysis.
5. To Understand Linear Least Square Estimation and RLS algorithms
6. To study the applications of adaptive signal processing

**Course Outcomes:**

- Upon successful completion of this course, the student will be able to:  
 At the end of this course students will demonstrate the ability to :
1. Comprehend adaptive system and functions.
  2. Evaluate the performance of various methods for designing adaptive filters through estimation of different parameters.
  3. Understand the concepts of gradient and mean square error performance in adaptive systems
  4. Analyse convergence and stability issues associated with adaptive filter design and come up with optimum solutions.
  5. Apply an adaptive filter algorithm that recursively finds the coefficients that minimize a weighted linear least squares cost function.
  6. Implement applications of adaptive signal processing.

	<b>Subject: Adaptive Signal Processing</b>	L
	<b>Adaptive Systems:</b>	
<b>Unit-1</b>	Adaptive Systems: Definition and characteristics, General Properties, Applications and examples of an adaptive system. Review of probability, random variables and random processes.	6
	<b>Wiener Filters:</b>	
<b>Unit-2</b>	Input signal and weight vectors, desired response and error, Mean Square Error (MSE), Principle of Orthogonally, FIR Wiener Filters, Wiener Hopfequation.	6
	<b>Steepest Descent Algorithms:</b>	
<b>Unit-3</b>	Searching the performance surface ó Methods & Ideas of Gradient Search methods ó Gradient Searching Algorithm & its Solution ó Stability & Rate of convergence ó Learning Curves Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.	6
	<b>Least Mean Square (LMS) Algorithms:</b>	
<b>Unit-4</b>	Derivation of LMS algorithm, Convergence, Stability and performance analysis of LMS Algorithm, Normalized Least-Mean-Square Algorithm.	6
	<b>Recursive Least Square Algorithms:</b>	
<b>Unit-5</b>	Linear Least Square Estimation Problem, Introduction to Recursive Least-Squares Adaptive filters, Matrix Inversion Lemma, RLS Algorithm.	6
	<b>Applications of Adaptive filtering:</b>	
<b>Unit-6</b>	System identification, Adaptive Equalization, noise cancellation, linear prediction, Echo Cancellation, Lattice Filters.	6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. "Adaptive Filter Theory", Simon Haykin, 3rd Ed, Prentice Hall Inc, 2002.
2. Bernard Widrow & Samuel. D. Stearns, Adaptive Signal Processing, Pearson Edu, 2001.

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**SYLLABUS OF Open Elective (Electronics & Tele. Communication Engg. Deptt.)**

**SEMESTER VI**

**6ETC04: Open Elective II: (i) ELECTRONIC COMMUNICATION SYSTEMS**

**Course Objectives:**

After completing this course the students should be able to:

1. Understand the basics of Electronic Communication System.
2. Understand the AM transmitter working.
3. Understand the working of AM and receiver and its parameters.
4. Understand FM transmitter working.
5. Understand of FM and receiver and its parameters.
6. Understand the pulse modulation techniques.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:

1. Demonstrate the basics of Electronic Communication systems.
2. Use the working of AM transmitter.
3. Demonstrate the working of AM receiver.
4. Able to understand working of FM transmitter.
5. Demonstrate the working of FM receiver.
6. Understand the various pulse modulation techniques.

**Unit I: Introduction to Electronic Communication System:**

Introduction Basic block diagram of Communication System, Modulation, Need for Modulation, Noise: Internal and external Noise. (No numericals expected)

**Unit II: Introduction to AM Transmitter:**

Amplitude Modulation Theory, Frequency Spectrum of AM, Representation of AM, Mathematical Expression of AM wave (only derivation, No numerical expected). Definitions of Modulation Index, SNR.

**Unit III: Introduction to AM Receiver:**

TRF Radio Receiver, Block diagram of Superheterodyne radio Receiver, Comparison. Definitions of Selectivity, Sensitivity and Fidelity

**Unit IV: Introduction to FM Transmitter:**

Frequency Modulation Theory, Frequency Spectrum of FM, Wideband and Narrowband FM. Advantages of FM over AM.

**Unit V: Introduction to FM Receiver:**

Block Diagram of FM Receiver, Comparison with AM Receiver. Stereo FM multiplex reception.

**Unit VI: Pulse Modulation Techniques:**

Introduction to pulse Modulation Techniques, PAM, PWM and PPM. Comparison.

**Text Books:**

1. Electronic Communication Systems, George Kennedy and Bernard Davis, Fourth Edition. Tata McGraw Hill Publishing Company Ltd.
2. Analog and Digital Communication Engineering, J. S. Chitode, Technical Publications.

**Reference Books:**

1. Communication Systems, 3rd Edition, Simon Haykin, John Wiley & Sons.
2. Telecommunications Principles Circuits Systems and Experiments, S. Ramabhadran, Khanna Publishers, Sixth Edition, 1997.

**6ETC04: Open Elective II (ii) WIRELESS COMMUNICATION (Electronics & Tele. Communication Engg.)**

**Course Objectives:**

1. To understand basics of Cellular System.
2. To study the fundamentals of cellular radio system, capacity & Coverage improvement techniques.
3. To understand mobile radio propagation mechanism and Multiple access techniques.
4. To understand operation of GSM in detail.
5. To study the CDMA techniques in.
6. To understand the WiFi and Bluetooth technology.

**Course Outcomes:**

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

1. Illustrate the evolution of cellular mobile system and understand cellular concepts.
2. Use fundamentals of cellular radio system.
3. Understand propagation mechanism in mobile radio system.
4. Demonstrate concepts of various 2nd and 3rd generation cellular systems and wireless data communication networks.

**Unit I: Introduction to Wireless Communication:**

Evolution of Mobile Communication, Basic Cell Fundamentals, Introduction to Cellular Telephone Systems: 1G, 2G,3G, 4G and 5G, Comparison of these systems.

**Unit II: Basic Cellular Concept:**

Frequency Reuse, Hand off Strategies, Types of Hand off, Cell improvement techniques : Cell Sectoring, Cell Splitting, Repeaters.

**Unit III: Basic Radio Propagation and Multiple Access Techniques:**

Basic propagation techniques: Reflection, Diffraction and Scattering, Comparison. Introduction to fading (numericals and types not expected). Introduction to FDMA, TDMA and CDMA, Comparison.

**Unit IV: Introduction to GSM:**

Basic GSM architecture block diagram, GSM Channels, Frame Structure, GSM handoffs such as NCHO, MAHO.

**Unit V: Introduction to CDMA Digital Cellular Standard:**

Basic Architecture block diagram of CDMA System, Comparison of CDMA and GSM. Introduction to WCDMA.

**Unit VI: Bluetooth and WiFi:**

Introduction to Bluetooth, Overall architecture, Advantages and Applications. Introduction to Wi-Fi, Advantages and Disadvantages.

**Text Books:**

1. Theodore S. Rappaport, "Wireless Communications: Principles & Practice", Second edn., Pearson Edn.(2002).
2. K. Pahlavan and P. Krishnamurthy, "Principles of Wireless Networks", Pearson Educn. Asia Publication(2002).
3. T. L. Singal, "Wireless Communication". McGraw Hill Education.

**Reference Books:**

1. A. F. Molisch, "Wireless Communications", Second Edition, Wiley Publication.
2. K. Shammugham, "Digital and Analog Communication.

\*\*\*\*\*

**Text Book:** Korth, and Sudarshan: Database System Concept, McGraw Hill, 4th Edition.

**References:**

1. Raghu Ramkrishnan : Database System, McGraw Hill
2. C.J.Date : Database System, 7th ed. (Pearson Education)
3. Connolly & Begg, : Database System, Low Price Ed.
4. Nawathe & Al-Masseri Database Systems (Pearson Education)

**6ETC04 Open Elective - II (OE-II): (iii) RENEWABLE ENERGY SOURCES (SOLAR & ELECTRIC VEHICLES)**

**Course Pre-Requisite:** None

**Course Objectives:**

1. To learn the concept of Solar cell
2. To understand Solar Photovoltaic systems
3. Understand the working of hybrid electric vehicles
4. The process of building normalization and apply to the database system.
5. Gaining the knowledge of electric drives and storage

**Course Outcomes:**

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

1. Understand the concept of Solar cell and estimate solar energy availability
2. Learn Solar cell Technologies
3. Understand the concept of Power Electronic Converters
4. Learn about Hybrid Electric Vehicles
5. Learn Electric drives
6. Learn about electric storage

Subject: **(iii) RENEWABLE ENERGY SOURCES (SOLAR & ELECTRIC VEHICLES)** L

	<b>Solar Cell Fundamentals and Solar Resource</b>	
<b>Unit-1</b>	Place of PV in World Energy Scenario, P-N Junction Diode: An Introduction to Solar Cells, solar radiation spectra, solar geometry, Earth Sun angles, and observer Sun angles, solar day length, Estimation of solar energy availability.	6
	<b>Solar Cell Technologies</b>	
<b>Unit-2</b>	Production of Si, Si Wafer-based Solar Cell Technology, Advances in c-Si Cell Processes Suitable for Near Future Commercialization, Solar Cell Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array.	6
	<b>Solar Photovoltaic Systems and Applications</b>	
<b>Unit-3</b>	Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control, Grid-Connected System and Standalone system, Solar Water Pumps, Solar street lights, Battery sizing.	6
	<b>Introduction to Hybrid Electric Vehicle</b>	
<b>Unit-4</b>	Review of Conventional Vehicle: Introduction to Hybrid Electric Vehicles: Electric Vehicle Evolution, Types of EVs, Types of battery for EVs.	6
	<b>Electric Drives:</b> Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor.	
<b>Unit-5</b>		6
	<b>Energy Storage:</b> Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles: - Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis.	
<b>Unit-6</b>		6
	<b>Total</b>	<b>36</b>

**Text Books:**

1. Chetan Singh Solanki, "Solar Photovoltaics- Fundamentals, Technologies And Applications" PHI third Edition.
2. D. P. Kothari, K. C. Singal and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Second Edition.
3. A. K. Babu, "Electric and Hybrid Vehicles", Khanna Publishers, 2019
4. S. P. Sukhatme and J.K. Nayak, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 3rd ed., 2008.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.

**References:**

1. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
2. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991
3. B.H. Khan, "Non-Conventional Energy Resources", McGraw Hill 2nd Edition 2017.
4. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
5. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
6. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012

**6ETC05: ENGINEERING ECONOMICS**

**Course Pre-Requisite:**

1. 3ETC03 Digital System Design
2. 5ETC01 Microcontroller

**Course Objectives:**

1. To familiarize the basic concepts and structure of Engineering Economics
2. To understand different principles of Engineering Economics
3. To learn the concepts Production and cost associated with it
4. To learn different types of cash flow
5. To learn depreciation analysis
6. To understand the concept of Banking system in India

**Course Outcomes:**

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

1. Learn basics of Engineering Economics
2. Understand and compute the production cost
3. Study different cash flow methods
4. to evaluate Engineering alternatives
5. Understand depreciation analysis
6. Understand Indian Banking System

	<b>Subject: 6ETC05: ENGINEERING ECONOMICS</b>	L
<b>Unit-1</b>	Definition and Scope of Engineering Economics , Subject Matter of Economics, Principles of Engineering Economics, Micro-economics Vs Macro-economics , Utility Analysis, Laws of diminishing utility analysis, derivation of demand curve and law of Demand, Elasticity of demand	6
<b>Unit-2</b>	Theory of Production: Theory, Importance, Isoquants and its properties, Marginal rate of Technical substitution, Law of variable proportions, Returns to Scale, Cost of Production and Cost of Curves, The law of supply, Price determination	6
<b>Unit-3</b>	Time value of Money, Techniques for adjusting time value of money, Uniform Gradient series factor, annuity, annuity due, calculation of deferred annuity , Types and components of cash flow, cash flow diagrams, principles of equivalence, Uses, significance and limitation of Cash flow statement	6
<b>Unit-4</b>	Evaluation of Engineering alternatives, Present worth method, Future worth Method, Equivalent annual worth comparison , Rate of return method, Project evaluation and Cost benefit analysis	6
<b>Unit-5</b>	Depreciation Analysis, Causes of depreciation, Depreciable property, depreciation methods, Digit method, Break even analysis, determination of breakeven point, Breakeven point in terms of quantity, sales and as percentage of capacity, Break even chart, Breakeven analysis assumptions, Managerial uses, Limitations	6
<b>Unit-6</b>	Commercial Banking, Functions of Commercial Banks , Role of Commercial banks in developing economy, sound baking system for under-developed countries, types of banks, balance sheet of a bank, New developments in banking system.	6

**Total 36**

**Text Book:** Engineering Economics and Costing, Second Edition, PHI, 2010 by Sasmita Mishra

**References:**

1. Engineering Economic Analysis, Volume 2, By Donald G. Newnan, Ted Eschenbach, Jerome P. Lavelle · 2004
2. ENGINEERING ECONOMICS, PHI Learning, By R. PANNEERSELVAM · 2013

**SUBJECT (PR): 6ETC06 COMMUNICATION NETWORK LAB**

- **Minimum Eight** Experiments based on syllabus of 6ETC01 **Communication Network** must be conducted.
- Course Objectives and Course Outcomes shall be specified based on the experiments conducted

**6ETC07- ELECTRONIC CIRCUIT DESIGN LAB (HARDWARE/SOFTWARE)**

Expt. No.	Name of Experiment
1	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of CMOS Inverter on silicon using appropriate ASIC design tool.
2	Layout, physical verification, placement & route for design, static timing analysis of two input NAND and NOR logic gates on silicon using appropriate ASIC design tool.
3	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of D Flip-flop on silicon using appropriate ASIC design tool.
4	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of $f=(A.B+C.D)$ on silicon using appropriate ASIC design tool.
5	To write Verilog code for BCD Counter and simulate with test bench.
6	To write Verilog code for 2-to-4 decoder and simulate with test bench, synthesis, implement on PLD.
7	To write Verilog code for 8-to-1 Multiplexer and simulate with test bench, synthesis, implement on PLD.
8	To write Verilog code for D flip-flop with reset and simulate with test bench, synthesis, implement on PLD.
9	ilog code for 4 Bit Full Adder in Module instantiation simulate with test bench, synthesis, implement on PLD.
10	To write Verilog code for sequence detector-1111 and simulate with test bench, synthesis, implement on PLD.

**Subject (Pr): 6ETC08 Python Programming Lab**

- **Minimum Eight** Experiments based on syllabus of 6ETC04 OE-II Introduction to Python must be conducted.
- Course Objectives and Course Outcomes shall be specified based on the experiments conducted

**6ETC09: MINI PROJECT**

Course Name	Course Code	Examination Scheme					University Assessment
		Theory		Practical		Total	
Mini Project	6ETC09	Internal Assessment	University Assessment	Internal Assessment	Presentation & Demo		50
				--	--	Term work 25	

**Course Objectives:**

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

**Course Outcomes:**

Upon completion of this course, students will demonstrate the ability to :

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Analyze the impact of solutions in societal and environmental context for sustainable development.
5. Excel in written and oral communication.
6. Demonstrate project management principles during project work.

**Guidelines for Mini Project**

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department.
- Students shall submit implementation plan, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out by all the groups of the students.

**Guidelines for Assessment of Mini Project:**

**Term Work:**

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in the semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
- |  |    |
|--|----|
| Marks awarded by guide/supervisor based on log book: | 10 |
| Marks awarded by review committee:                   | 10 |
| Quality of Project report:                           | 5  |

**Guidelines for Assessment of Mini Project Practical/Oral Examination:**

- Report should be prepared as per the guidelines issued by the College.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

**Assessment criteria of Mini Project**

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Full functioning of working model as per stated requirements
8. Contribution of an individual's as member or leader
9. Clarity in written and oral communication

**Note:**

An orientation program of 15 hours duration / MOOC to be offered to the students during

(a) V<sup>th</sup> semester : Indian Constitution

(b) VI<sup>th</sup> semester : Indian Traditional Knowledge