NOTIFICATION

No. 89/2020 Date : 26/10//2020

Subject : Implementation of new Syllabi of Semester III & IV of B.E. (C.B.C.S.) as per A.I.C.T.E. Model Curriculum…

It is notified for general information of all concerned that the authorities of the University have accepted to implement new Syllabi of Semester III & IV of B.E./B.Text. E./B.Tech. (Chem.Tech.) (Food, Pulp & Paper, Oil & Paint and Petrochemical Tech.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2020-21 & onwards as per "**Appendix – A**" as given below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

SYLLABUS OF SEM. III & IV B.E. (ELECTRONICS & TELECOMMUNICATION ENGG.)

Semester-III

3ETC1 - ENGINEERING MATHEMATICS-III

Course Requisite: 1. (IA1) Engineering Mathematics-I 2. (IB1) Engineering Mathematics-II

Course Objectives:

1. To deal with linear differential equations.
2. Understand Laplace transforms .
3. Introduction to geometry of curves, two and three-dimensional regions and calculus of vector valued functions.
4. To equip students with necessary knowledge and skills to enable them to handle mathematical operations of complex analysis .
5. Understand the computational details behind certain numerical methods and their convergence.
6. To deal with system of differential and difference equations in the study of electrical/electronic and systems.

Outcomes: After successfully completing the course, the students will be able to

1 . Demonstrate the knowledge of differential equations to solve engineering problems of analog systems.
2 . Apply Laplace transform to solve differential equations.
3. Apply knowledge of vector calculus.
4. Comprehend knowledge of complex analysis in terms of complex variables, harmonic functions and conformal mapping.
5. Apply numerical methods to obtain approximate solutions to mathematical problems.
6. Identify and solve certain forms of partial difference equations as applied to discrete systems.

SECTION - A

Unit-I : Ordinary Differential Equations: - Complete solution, Operator D, Rules for finding complementary function, the inverse operator, Rules for finding the particular integral, Method of variations of parameters, Cauchy's and Legendre's linear differential equations. (7)

Unit-II: Laplace transforms: definition, standard forms, properties of Laplace transform, inverse Laplace transform, Laplace transform of some basic functions, initial and final value theorem, convolution theorem, Solution of linear differential equations using Laplace transform. (7)

Unit III : Vector Calculus: - Scalar and Vector point functions, Differentiation of vectors, Curves in space, Gradient of a scalar point function, Directional derivatives, Divergence and curl of a vector point function and their physical meaning, expansion formulae (without proof), irrotational and solenoidal vector fields. Fourier transforms: Fourier sine and Fourier cosine transforms and integrals . (7)

SECTION- B

Unit IV : Complex Analysis: - Functions of complex variables, Analytic function, CauchyReimann conditions, Harmonic function, Harmonic conjugate functions, Milne's method. Conformal Mappings: Translation, Rotation, Magnification, Inversion and Bilinear Transformation, expansion of function in Taylor's and Laurent's series. (7)

Unit V : Numerical Methods: Solution of Nonlinear and Polynomial Equations : False Position, Newton Raphson Method. Solution of Linear Systems Equations: Gauss Elimination method, Gauss Seidel Iterative Method, Relaxation method Solution of Differential Equations: Euler's method, Runge-Kutta method, Picards method. (7)

Unit VI : (a) Difference Equation:- solution of difference equations of first order, solution of difference equations of higher order with constant coefficient.
(b) **Partial differential equation of first order of following form-** (i) f (p, q) = 0; (ii) f (p, q, z)=0; (iii) f(x, p) = g (y, q); (iv) Pp + Qq =R (Lagrange's Form); (v) Z=px+qy+f(p, q) (Clairaut form) (7)

Text Books:

1. Elements of Applied Mathematics by P. N. Wartikar and J. N. Wartikar. Poona Vidhyarthi Publisher
2. Higher Engineering Mathematics by B.S.Grewal. Khanna Publishers
3. Introduction to method of Numerical Analysis- S. S. Shastry, Second Edition, PHI Pvt. Ltd.,New Delhi.

References:

1. A Mathematical Companion for Science and Engineering Students – Brettenbach, Oxford University Press, 2008
2. Advancing Engg. Mathematics, E.K.Kreyzig, John Wiley
3. Numerical Method for Mathematics Science and Engineering, John H. Mathew, PHI 4. Numerical Methods - Principles, Analysis & Algorithms Pal, Oxford.

3ETC02 - Electronic Devices & circuits Max. Marks: 80

Course Requisite:

1. Engineering Physics

Course Objectives:

1. To understand detail analysis of Electronic devices.
2. To understand use of electronic devices for various applications in Electronic circuits.
3. To analyze various electronic circuits.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Comprehend the knowledge of diode and its applications in rectifier and regulator circuits.
2. Understand basics of BJT, JFET, MOSFET, UJT and their operational parameters.
3. Understand feedback concept, topologies and their applications.
4. Implement and analyze various electronic circuits.

	Subject: Electronic Devices & circuits	L
Unit-1	**PN junction diode:** Formation of p-n junction, biasing the diode, current equation and V-I characteristics of diode, static and dynamic resistance, Analysis of Half Wave Rectifier (HWR), Full Wave Rectifier (FWR), introduction to filters C, L,LC and CLC filters, working of diode as a Switch, Zener diode and its application as voltage regulator.	06
Unit-2	**Waveshaping:** Analysis of RC low pass, and high pass filters for Sinusoidal, Step, Pulse, Square signal, analysis of clipping and clamping circuits using diodes.	06
Unit-3	**Bipolar Junction Transistors:** Operation of PNP and NPN transistor, CB, CE and CC configurations with characteristics and parameters, transistor as a switch, Transistor switching times, dc load line, transistor biasing methods, bias stability, Introduction to voltage divider biased CE amplifiers using h-parameter model.	06
Unit-4	**Feedback amplifiers**: Feedback concept, effects of negative feedback, basic feedback topologies **Sinusoidal oscillators**: Barkhausen's criteria, Hartley, Colpitts, RC Phase shift, Wein bridge and crystal oscillators.	06
Unit-5	**Multistage Amplifiers**: Need of multistage, direct coupled amplifier, RC coupled amplifier, transformer coupled amplifier, emitter follower, Darlington emitter follower, bootstrapping principle (analysis not expected).	06
Unit-6	**JFET:** Theory, construction and characteristics: parameters (μ, gm & rd) **MOSFET**: Theory, construction and characteristics of enhancement & depletion type MOSFET. **UJT:** Theory, construction and characteristics; UJT as relaxation oscillator.	06
	Total	**36**

Text Books:

1. David Bell: Electronic Devices and Circuits, Oxford University Press, 2010.
2. Milliman and Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi.

References:

1. Robert L.Boylestad, "Electronic Devices and Circuit theory", Publ. Pearson Education.
2. Floyd, "Electron Devices" Pearson Asia 5th Edition, 2001.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.

3ETC06 - ELECTRONIC DEVICES AND CIRCUITS - LAB

Course Requisite:

1. Engineering Physics
2. 3ETC02 Electronic Devices and Circuits

Course Objectives:

1. To verify characteristics of various semiconductor devices.
2. To determine and verify various performance parameters of electronic devices and circuits.
3. To provide basic experimental exposure about operation and applications of electronic devices.

Course Outcomes:

1. Acquiring basics of parameters and operation of various semiconductor devices.
2. Implementation of basic circuits using electronic devices.
3. Verification and analysis of performance of electronic circuits.

List of Experiments :

Experiment No.	Aim of Experiment
Expt - 1	To verify V-I characteristics of p-n junction diode and obtain static and dynamic resistance values.
Expt – 2	To calculate efficiency and ripple factor of Half wave, Full wave and Bridge wave rectifier.
Expt - 3	To study different types of filter circuits and calculate its ripple factor for C-filter.
Expt - 4	To study Zener diode as a voltage regulator.
Expt – 5	To observe the response of RC Low pass circuit for a square wave input for different time Constant i) RC >>T ii) RC = T iii) RC <<T.
Expt - 6	To observe the response of RC High pass circuit for a square wave input for different time Constants i) RC>>T ii) RC = T iii) RC<<T.
Expt – 7	To obtain output characteristics of the clipping circuits for different reference voltages and to verify the responses.
Expt – 8	To study and observe the performance of various clamper circuit.
Expt – 9	To verify characteristics of CE mode of BJT and compute its parameters such as gain(β),input and output Impedance.
Expt – 10	To compare calculate and observe frequencyresponse of oscillationsof 3 stage RC phase shift oscillator.
Expt - 11	Tocomparecalculateand observefrequencyresponse ofoscillationsofRC Wein Bridge oscillator.
Expt – 12	To plot frequency response of RC coupled amplifier and determine its bandwidth.
Expt – 13	To plot frequency response of Transformer coupled amplifier and determine its Bandwidth.
Expt – 14	To sketch the drain and transfer characteristics of n-channel JFET and determine ac drain resistance, trans-conductance and amplification factor
Expt – 15	To sketch V-I characteristics of UJT and determine Intrinsic stand-off ratio
Expt – 16	To analyze the response of Rectifier, Amplifier, Oscillator, using simulation software.

* Minimum 08 experiments should be conducted out of above enlisted.

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3ETC03 - DIGITAL SYSTEM DESIGN

Max. Marks: 80

Course Requisite:

1. Engineering Physics

Course Objectives:

1. To study basic concepts of Boolean algebra, number systems and codes.
2. To study techniques of minimization of Boolean expression.
3. To study the formal procedures for the analysis and design of combinational circuits.
4. To study the formal procedures for the analysis and design of sequential circuits.
5. To learn digital logic families, Programmable logic Devices.
6. To learn the semiconductor memories and mapping.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Use Boolean algebra to solve logic functions, minimization techniques, number systems and its conversion, arithmetic functions.
2. Identify, analyze and design combinational and sequential circuits.
3. Understand digital logic families and their characteristics.
4. Use the knowledge of semiconductor memories and mapping of memories, programmable logic devices in digital design.

	Subject: DIGITAL SYSTEM DESIGN	L
Unit-1	**Number systems and codes:-** Number system and their conversions, BCD codes, Octal codes, Hexadecimal codes, Excess-3 code, Gray Code, Arithmetic Operations using 1's complement and 2's complement Introduction, Basic Digital Circuits: AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR.	06
Unit-2	**Logic gates, Boolean Algebra and Minimization Techniques:-** Boolean Algebra, Demorgans Theorem, Simplifications using Boolean Algebra , SOP and POS form, K-map representation and minimization of logical functions upto 4 variables, don't care conditions, Quine McCluskey method.	06
Unit-3	**Combinational logic design using 74XX/54XX MSI chip:-** Adders, Subtractors, 4-bit parallel adder, look ahead carry BCD adder, MUX, DEMUX, Decoders, Encoders, Code Converters, Comparators, Parity Generator/Checker, BCD to 7 segment decoder, combinational logic design using ROM, PLA, PAL.	06
Unit-4	**Flip-flops, Registers and Counters:-** S-R, J-K, Master slave J-K, D-type, T-type. Shift Registers: Mode of operations of shift registers, Universal Shift Register. Counters: Asynchronous and Synchronous counter, up/down counter, MOD-N counter, Ring counter, Johnson counter, Frequency Division Counter.	06
Unit-5	**Logic families and Memories:-** TTL NAND gate, specification noise margin, propagation delay, fan-in, fan-out, tri-state TTL, ECL, CMOS. Semiconductor Memories: - RAM, ROM, EPROM, EEPROM, SRAM, DRAM.	06
Unit-6	**Analysis of Clocked Sequential Networks**:- Moore and Mealy Machine, State table, State Assignment, State Reduction, State Transition diagram, Sequence Generator, Sequence Detector.	06
	Total	**36**

Text Books:

1. M.Morris Mano and M.D.Ciletti, "Digital Design", Pearson Education.
2. R P Jain, "Modern Digital Electronics", TMH.

Reference Books:

1. Wakerly, "Digital Design: Principles and Practices", 3rdedition, Pearson Education, 2004.
2. Charles H. Roth, "Fundamentals of Logic Design", 4th Edition, Jaico Publication
3. Lee S.C, "Digital Circuits and Logic Design", PHI
4. Richard S. Sandige, "Modern Digital Design", McGraw-Hill Series in Electrical Engineering.

3ETC07 - DIGITAL SYSTEM DESIGN - Lab

Course Requisite:

1. Engineering Physics lab

Course Objectives:

1. To impart the concepts of digital electronics.
2. To provide students basic experimental experiences in the operation of various digital logic Families.
3. To learn the operation of various logic gates and their implementation using digital IC's.
4. To learn the realization of various combinational and sequential circuits.
5. To learn Semiconductor memories and mapping.

Course Outcomes:

After successfully completion of the lab course the students will be able to:

1. Apply practically the concepts of digital electronics.
2. Explain the operation and characteristics of various digital logic families.
3. Understand the operation of various logic gates and their implementation using digital IC's.
4. Design and implement various combinational logic circuits.
5. Design and implement various sequential logic circuits.
6. Design and mapping of various types of memories.

Expt. No.	Experiment List
Expt-1	To study and verify the operation of various digital logic families.
Expt -2	To study and verify the operation of logic gates.
Expt -3	Design and implementation of Adders and Subtractors using logic gates.
Expt -4	Design and implementation of code converters using logic gates.
Expt -5	Design and implementation of multiplexer using logic gates and IC.
Expt -6	Design and implementation of demultiplexer using logic gates and IC.
Expt -7	Design and implementation of code converters using logic gates.
Expt -8	Design and implementation of Magnitude Comparator using logic gates and IC.
Expt -9	Design and implementation of odd/even parity checker /generator using IC.
Expt -10	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.
Expt -11	Construction and verification of ripple counters.
Expt -12	Design and implementation of 3-bit synchronous up/down counter

* Minimum 08 experiments should be conducted out of above enlisted.

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3ETC04 - ELECTROMAGNETIC WAVES Max. Marks: 80

Course Requisite:

1. Engineering Mathematics-I
2. Engineering Mathematics-II
3. Engineering Mathematics-III

Course Objectives:

The objectives of the course are,

1. To introduce basic mathematical concept of coordinate system and vector integrals.
2. To impart knowledge of the basic concepts of electric fields.
3. To impart knowledge of the basic concepts of magnetic fields.
4. To understand the Maxwell's Equations for Electric & Magnetic Field, Boundary conditions and their interpretation.
5. To introduce concept of propagation of electromagnetic waves in free space, conductors and dielectrics.
6. To understand, analyze and evaluate the radiation of electromagnetic wave from theoretical and practical antennas.

Course Outcomes:

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

1. Understand the coordinate systems and vector integrals.
2. Evaluate Electric Field Intensity for different charge distributions.
3. Evaluate Magnetic Field Intensity due to current carrying conductors.
4. Understand scientifically about Maxwell's equations & Boundary conditions.
5. Characterize uniform plane wave & can calculate reflection and transmission coefficient of waves at media interface.
6. Understand principle of radiation and radiation characteristics of theoretical & practical antennas.

	Subject: Electromagnetic Waves	L
Unit-1	**Introduction to Vector analysis:** Coordinate systems, Basics of Vectors: Vector products, Projection of vectors, Gradient, Divergence & Curl, Vector integrals, Divergence Theorem & Stokes Theorem.	06
Unit-2	**Electrostatics:** Introduction to Coulomb's law &Electric Field Intensity, Evaluation of Electric Field Intensity due to point charge, line charge & surface charge distribution. Introduction to Electric Flux, Electric Flux Density, Electrostatic potential, Potential gradient &Electric dipole.	06
Unit-3	**Magnetostatics:** Introduction to Biot Savart's law, Ampere's circuital law, Magnetic Field Intensity (without numericals), Evaluation of Magnetic Field intensity due to infinite, finite & circular current carrying conductors. Introduction to Magnetic Flux, Magnetic Flux Density, Magnetic dipole.	06
Unit-4	**Maxwell Equations & Boundary Conditions:** Derivation of Maxwell's Equations for Electric & Magnetic Field (without numericals). Boundary condition at dielectric-dielectric interface, dielectric-conductor interface &Boundary conditions for magnetic materials interface.	06
Unit-5	**Electromagnetic Wave Propagation:** Uniform plane wave, Propagation of wave, Formulation of wave equation in free space, dielectric &conducting medium, Skin depth, Poynting Theorem, Reflection and refraction of electromagnetic waves with normal incidence at dielectric interface.	06
Unit-6	**Radiation:** Scalar & Vector magnetic potential, Retarded Potential, Radiation of Electromagnetic wave from the Hertzian Dipole ,Quarter wave Monopole and Half-wave Dipole antennas.	06
	Total	**36**

Text Books:

1. William H.Hayt,Jr and John A.Buck., "Engineering Electromagnetics", Tata McGraw-Hill Publishing Ltd.

2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India

Reference Books :

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005

2. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997. 4. David Cheng, Electromagnetics, Prentice Hall Course

3ETC05: OBJECT ORIENTED PROGRAMMING Max. Marks: 80

Course Requisite:

4. Computer Programming

Course Objectives:

1. To learn object-oriented concepts and build simple applications using C++ and Java.
2. To understand the basic concepts and techniques which form the object-oriented programming paradigm

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Justify the basic concepts of object-oriented programming such as data types, functions, classes, objects, constructors, inheritance, overloading etc.
2. Design, implement, test, and debug simple programs in C++.
3. Describe how the class mechanism supports encapsulation and information hiding.
4. To know the concept of operator overloading
5. Understand inheritance in C++
6. Design and test the implementation of Java programming concepts

	Subject: OBJECT ORIENTED PROGRAMMING	L
Unit-1	Principles of object-oriented Programming: OOP'S paradigm, basic concept of OOP'S, benefits of OOP'S, Four pillars of OOP, structure of C++ programming, basic data types.	06
Unit-2	User defined data type, derived data type, Abstract data types in C++, operators and control statement, Functionsin C++: Functions, Function over loading, Friend Functions and virtual functions.	06
Unit-3	Classes and objects in C++: Types of classes and its use, concept of object and its implementation, constructor and destructors.	06
Unit-4	Operator and their definition, overloading unary and binary operator, rules for overloading operators, overloading binary operators using friends and string manipulation.	06
Unit-5	Inheritance in C++: Extending classes: Multilevel Inheritance, Multiple inheritances, Hierarchical inheritance, Hybrid inheritance, Virtual base classes and Abstract classes.	06
Unit-6	Introduction to Java programming, JVM, Java programming constructs: variables, primitive data types, identifier, literals, operators, expressions, primitive type conversion and casting, Basics of classes, objects, creating objects, and methods in Java.	06
	Total	**36**

Text Books:

1. E Balagurusamy, "Object Oriented Programming Using C++ and JAVA", Tata McGraw-Hill.
2. E Balagurusamy, "Object Oriented Programming Using C++" ,Tata McGraw-Hill.

Reference Books :

1. Bjarne Stroustrup, "C++ Programming Language", Pearson Education.
2. H.M.Dietel and P.J.Dietel, "Java How to Program" Pearson Education/PHI, Sixth Edition.
3. Robert Lafore, "Object-Oriented Programming in C++ ", Pearson Education India, (4th Edition).
4. Herbert Schildt , "Java : The Complete Reference" Tata McGraw-Hill (7th Edition).
5. Yeshwant Kanetkar "Let us C++", BPB Publications.
6. Dr. N.B. Vekateswarlu, Dr. E.V. Prasad, "Learn Object Oriented Programming Using Java: An UML Based", S. Chand Publication.

3ETC08 : OBJECT ORIENTED PROGRAMMING -LAB.

Course Requisite:

1. Computer Programming
2. 3ETC05 Object Oriented Programming

Course Objectives:

1. Design, implement, test, and debug simple programs in an object-oriented programming language.
2. Design and test the implementation of C++ programming concepts.
3. Design and test the implementation of java programming concepts.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Justify the basics of object-oriented design and the concepts of encapsulation, abstraction, inheritance, and polymorphism.
2. Design, implement, test, and debug simple programs in an object-oriented programming language.
3. Describe how the class mechanism supports encapsulation and information hiding.
4. Design and test the implementation of C++ and java programming concepts.

List of Experiments :

Experiment No.	Aim of Experiment
Expt - 1	Write a C++ program to swap two variables a) Using third variable b) Without using third variable.
Expt – 2	Write a program in C++ to print the area and perimeter of a rectangle.
Expt - 3	Write a C++ program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
Expt - 4	Develop programs to implement the concepts of classes and object, accessing members: e.g. a. Design an EMPLOYEE class to contain Data members: Employee_Number, Employee_Name, Basic_Salary, All_Allowances, IT, Net_Salary. Member functions: to read the data of an employee, to calculate Net_Salary and to print the values of all the data members.
Expt – 5	Write a program in C++ to implement parameterized constructor and copy constructor.
Expt - 6	Write a C++ program to implement function overloading.
Expt – 7	Write a program in C++ illustrating the use of virtual functions in a class.
Expt – 8	Write a C++ program to overload unary operator for inverting the value of data variable using member function.
Expt – 9	Write a program in C++ to demonstrate multiple inheritances.
Expt – 10	Write a program in C++ to demonstrate multilevel inheritance.
Expt - 11	Write a program in C++ to implement virtual base class.
Expt – 12	Write a java program to Calculate Circle Area.
Expt – 13	Write a program in Java that reads a number in meters, converts it to feet, and displays the result.

* Minimum 08 experiments should be conducted out of above enlisted.

Semester - IV

4ETC02 - ANALOG CIRCUITS Max. Marks: 80

Course Requisite:

1. (3ETC02) Electronic Devices and Circuits

Course Objectives:

1. To understand the basics and internal structure of Op-Amp.
2. To analyze and design linear and non-linear applications of Op-Amp.
3. To understand and design concepts of voltage regulators.
4. To study and synthesize the waveform generators using IC 555 and IC 565.
5. To demonstrate applications of Op-Amp in temperature monitoring.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Perform evaluation of the switching behavior of semiconductor devices.
2. Comprehend the knowledge of basic concepts and performance parameters of Op-Amp.
3. Use Op-Amp for implementation of linear and non-linear applications.
4. Comprehend the knowledge of PLL, its applications and data converters.

	Subject: Analog Circuits	L
Unit-1	**Operational amplifier** Block diagram of Op-Amp, differential amplifier configurations using BJT, constant current source, level shifting, transfer characteristics, frequency response, study of ICuA741, Op-Amp parameters, Inverting and non inverting amplifiers	06
Unit-2	**Linear applications of Op-Amp:** Theory & Design of scaling, summing, differential amplifier, integrator and differentiator, sinusoidal RC oscillators: RC-phase shift, Wein bridge oscillator using IC 741.	06

Unit-3	**Non Linear Applications of Op-Amp:** Theory & Design of Op-amp IC 741 based comparator, zero-crossing detector, window detectors, Schmitt trigger, astable multivibrator as square and triangular wave generator, monostable multivibrator	06
Unit-4	Design of Voltage regulators using IC 723 and LM 317, Design of instrumentation amplifier, bridge amplifier, temperature Controller/indicator using RTD.	06
Unit-5	Introduction to IC 555, IC 555 based design of Astable, Monostable multivibrator and their applications, A to D converters: Successive approximation & Dual Scope, D to A converters : Weighted Register & R-2R Ladder.	06
Unit-6	PLL: Operation of phase lock loop system, transfer characteristics, lock range and capture range, study of PLL IC LM 565 and its applications as AM detector, FM detector, Design of Butterworth first and second order low pass, high pass, all pass filter, design of notch filter.	06
	Total	**36**

Text Books:

1. R.A. Gayakwad, “OP-AMP and Linear Integrated Circuits”, Prentice Hall/ Pearson Education Publications.
2. K R Botkar “Integrated Circuits” Khanna Publications.
3. Sergio Franco, “Design with Linear Integrated Circuits & Op-Amps”,TMH Publications.

References:

1. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley Intl. Publication.
2. Paul Horowitz, W. Hill, “The art of Electronics”, Cambridge Publications.

4ETC07 – ANALOG CIRCUITS LAB

Course Requisite:

1. (3ET3) Electronic Devices and Circuits.
2. (4ETC02) Analog Circuits

Course Objectives:

1. To verify operation of various wave shaping circuits.
2. To demonstrate linear and non-linear applications of Op-Amp.
3. To analyze multivibrator circuits using BJT and Op-Amp.
4. To understand functions and characteristics of PLL.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Implement wave shaping circuits using passive components, diode and BJT and perform their analysis.
2. Demonstrate linear and non-linear applications of Op-Amp.
3. Implement PLL in certain applications.

List of Experiments :

Experiment No.	**Aim of Experiment**
Expt - 1	To verify Op-Amp IC 741 as an inverting and non- inverting amplifier with a specific gain value.
Expt – 2	To demonstrate integrator and differentiator circuit using Op-Amp IC 741.
Expt - 3	To verify RC- phase shift oscillator using Op-Amp IC 741.
Expt - 4	To verify Op-Amp IC 741 as a Schmitt trigger and calculate the hysteresis voltage.
Expt – 5	To verify operation of astable multivibrator using Op-Amp IC 741.
Expt - 6	To plot frequency response of first order Butterworth LPF for a specific pass-band gain and cut-off frequency.

Expt – 7 To verify characteristics of PLL.

Expt – 8 Application of PLL as AM detector/FM detector/frequency translator (Any one application)

Expt – 9 Design transistorized series voltage regulator

Expt – 10 Design a low voltage variable regulator to 7 V using IC 723.

Expt - 11 Design of summing amplifier using IC 741.

Expt – 12 Design of Schmitt trigger.

Expt – 13 Design of integrator and differentiator.

Expt – 14 Design of sinusoidal RC phase shift oscillator.

Expt – 15 Design and setup a Wien-bridge oscillator.

Expt – 16 Design the square and triangular wave generator using IC 741.

Expt – 17 Design a Butterworth high pass filter with specifications.

* Minimum 08 experiments should be conducted out of above enlisted.

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4ETC03 - NETWORK THEORY Max. Marks: 80

Course Requisite:

1. Electrical Engineering.
2. Engineering Mathematics.

Course Objectives:

1. To understand fundamental concepts of Node and Mesh analysis for linear circuits.
2. To study Network Theorems for circuit analysis.
3. To study Graph Theory for network analysis.
4. To apply Laplace Transform Technique for analysis of linear circuits.
5. To study Two Port Network parameters.
6. To study Network Functions.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Analyze electrical circuits using Mesh and Node analysis.
2. Apply suitable Network Theorem to analyze electrical circuits.
3. Draw oriented Graph of the network to determine their currents and voltages.
4. To implement the concept of Laplace Transform for electrical circuit analysis.
5. To apply Two-Port network theory for electrical network analysis.
6. To evaluate different Network Functions.

	NETWORK THEORY	L
Unit-1	**Node and Mesh analysis**: Circuit components, assumptions for circuit analysis, Sources of electrical energy, Source transformation, Kirchoff's laws, Node and Mesh analysis, Matrix approach of network containing voltage and current sources and reactances, Network equations for RLC networks.	08
Unit-2	**Network Theorems**: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Compensation theorem, Tellegen's theorem as applied to AC cicuits.	08
Unit-3	**Graph theory and network equations**: Graph of a network, Trees, cotrees and loops, Incidence matrix, Tie set and Cut set of a network, Analysis of a network using Tie set and Cut set matrix, Network equilibrium equations (without magnetic coupling), Duality.	08

Unit-4	**Network Analysis using Laplace Transform**: Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL and RLC networks with and without initial conditions. Initial and Final value theorems.	08
Unit-5	**Two port networks**: Open circuit impedance parameters, Short circuit admittance parameters, Transmission parameters, Inverse transmission parameters, Hybrid and Inverse hybrid parameters, Condition for reciprocity and symmetry of a two port network, Interconnection of two port networks.	08
Unit-6	**Network functions**: Ports and terminal pairs, Network functions, poles and zeros, Necessary conditions for driving point function, Necessary conditions for transfer function, Application of network analysis in deriving functions, Time domain behaviour from pole-zero plot, driving point and transfer impedance functions of LC networks.	08
	Total	**48**

Text Book: D. Roy Choudhary, "Networks and Systems", New Age International.

Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall,3rd Edition.
2. Sudhakar A., Shyammohan S. P. "Circuits and Network" ; Tata McGraw-Hill New Delhi, 1994
3. W. H. Hayt, J. E. Kemmerly and S. M. Durbin, "Engineering Circuit Analysis", 7th Edition, Tata McGraw-Hill education private Limited, New Delhi.
4. Abhijit Chakrabarti, "Circuit theory, Analysis and Synthesis",Dhanpat Rai and Co. Pub.

4ETC08 - NETWORK THEORY - LAB

Course Objectives:

1. To apply knowledge of Mesh and Node analysis for a given network.
2. To learn various network theorems and apply them to solve networks.
3. To apply knowledge of Two Port network and Network Functions to analyze given network.

Course Outcomes:

After successfully completion of the lab course the students will be able to:

1. To apply knowledge of Mesh and Node analysis for a given network.
2. To apply various network theorems to solve networks.
3. To apply knowledge of Two Port network and Network Functions to analyze given network.

Expt. No.	Experiment List
Expt-1	To verify Node Analysis for electric circuit.
Expt -2	To verify Mesh Analysis for electric circuit.
Expt -3	To verify Superposition theorem for a given network.
Expt -4	To verify Thevenin's theorem for a given network.
Expt -5	To verify Norton's theorem for a given network.
Expt -6	To verify Reciprocity theorem for a given network.
Expt -7	To verify Maximum Power Transfer theorem for a given network.
Expt -8	To determine and verify open circuit (Z) Impedance parameters of a given Two Port network.
Expt -9	To determine and verify short circuit (Y) Admittance parameters of a given Two Port network.
Expt -10	To determine and verify Transmission (ABCD) parameters of a given Two Port network.
Expt -11	To determine and verify Hybrid (h) parameters of a given Two Port network.
Expt -12	To find the driving point Impedance for a given network.
Expt -13	To find the Voltage Transfer Ratio for a given network.
Expt -14	To study RLC series circuit using any simulation Tool.
Expt -15	To study RLC parallel circuit using any simulation Tool.

- Minimum 08 experiments should be conducted out of above enlisted.

4ETC04 – SIGNALS AND SYSTEMS Max. Marks: 80

Course Requisite: Engineering Mathematics-III

Course Objectives:

1. Understand the fundamental characteristics of signals and systems.
2. Understand signals and systems in terms of both the time and transform domains.
3. Develop the mathematical skills to solve problems involving convolution and sampling.

Course Outcomes:

After successfully completing the course, students will be able to

1. Understand the continuous time signals and systems mathematically and their classification along with the mathematical operations that can be performed on them.
2. Understand the spectral characteristics of continuous-time periodic signals using Fourier series.
3. Analyze the spectral characteristics of continuous-time aperiodic signals and systems using Fourier Transform.
4. Apply the Laplace transform for analysis of continuous-time systems.
5. Understand the Discrete Time signals and systems mathematically and understand their classification along with the mathematical operations that can be performed on them.
6. Analyze the spectral characteristics of Discrete Time signals and systems using Discrete Time Fourier Transform.

	Subject: Signals and Systems.	L
Unit-1	**Continuous time signals and systems**: Signal Classification, Energy and Power Signal, Signal Operations, Signal models, Even and Odd functions, convolution, System Classification	06
Unit-2	**Continuous-Time Signal Analysis -The Fourier Series:** Periodic Signal Representation by Trigonometric Fourier Series, Existence and Convergence of Fourier Series, Gibbs Phenomenon, Exponential Fourier Series, Magnitude and phase plots of Fourier coefficients.	06
Unit-3	**Continuous-Time Signal Analysis-The Fourier Transform:** Aperiodic Signal Representation by Fourier Integral, Properties of Fourier Transform, Signal Transmission Through LTIC Systems, Signal energy, Inverse Fourier Transform, plotting Fourier Spectrum.	06
Unit-4	**Continuous-Time System Analysis Using Laplace Transform**: Laplace Transform, Region of convergence, Inverse Laplace transforms Application of Laplace transform for determination of solution of differential equation and System realization up to second order, Frequency response of LTIC system.	06
Unit-5	**Time-Domain Analysis of Discrete-Time Signals & Systems:** Signal Operations, Classification of Discrete-Time Systems, Discrete-Time System Equations, System response to Internal condition, Unit Impulse Response, System response to External Input, Classical Solution of Linear Difference Equations.**Sampling and Reconstruction:** Sampling theorem, signal reconstruction spectral.	06
Unit-6	**Fourier Analysis of Discrete-Time Signals:** Discrete-Time Fourier Series (DTFS), Aperiodic Signal Representation by Fourier Integral, Properties of DTFT, Relationship between DTFT & CTFT.	06
	Total	**36**

Text Books:

1. Lathi B. P., "Principles of Linear Systems and Signals" Second Edition (International Version) Oxford University Press.
2. Alan V. Oppenheim & Alan S. Willsky with S. Hamid Nawab, "Signals & Systems" PHI Publication, Second Edition.

Reference Books:

1. Ambardar A., "Analog And Digital Signal Processing", Thomson Learning-2005.
2. Simon Haykin, Barry Van Veen, "Signals & Systems", IInd Edition, Wiley Pub.
3. Michael J. Roberts, "Signals and Systems Analysis Using Transform Methods and MATLAB", Mc Hill Publication.

4ETC09 – SIGNALS AND SYSTEMS - LAB

Course Requisite:

4ETC04 Signals & Systems.

Course Objectives:

1. To use software to visualize analysis of Signals and System.
2. To manipulate the time signals and identify the type of given system.

Course Outcomes:

1. After successful completion of this course, students will be able to
2. Generate different plots and explore results to draw valid conclusions and inferences in Signal Processing.
3. Enable on how to approach for requirement of signal processing and system design using simulation tools.
4. Familiarize with the concepts of sampling.

List of Experiments :

Experiment No.	Aim of Experiment
Expt - 1	Study of Signal Processing Functions used in MATLAB/SCILAB.
Expt – 2	Program to generate standard continuous Time Signals.
Expt - 3	Program to generate standard discrete Time Signals.
Expt - 4	Program to perform basic operations on Signals.
Expt – 5	Program to find Even And Odd parts of a signal.
Expt - 6	Program to check Periodicity of signals.
Expt – 7	Program to find the Energy and Power of a Signal.
Expt – 8	Program to identify a given system as linear/ non-linear, time variance/ invariance property of a given system.
Expt – 9	Program to demonstrate the time domain sampling of band limited signals (Nyquist theorem).
Expt – 10	Program to find Fourier transform of given signal.
Expt - 11	Implement system equation using Simulnk/Xcos to find output of system for different input signals.
Expt – 12	Find unit step response of system described by transfer function using Simulink/Xcos.

* Minimum 08 experiments should be conducted out of above enlisted.

4ETC05 – VALUES & ETHICS (HS) Max. Marks: 80

Course Requisite:

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship, and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

	Subject: Values & Ethics	L
Unit-1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validations the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	06
Unit-2	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity.	06
Unit-3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship Incorporating Universal Human Values in Technical Education (An AICTE Initiative), Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.	06
Unit-4	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature, Interconnectedness, and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.	06
Unit-5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human Conduct , Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems.	06
Unit-6	Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations. (6 Hrs) Note: Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.	06
	Total	**36**

Text Books and Teachers Manual :

1. A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Asthana, G.P. Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Asthana, G.P. Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

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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

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

Text Books:

1. Gaonkar R.S: ñMicroprocessor Architecture Programming and Applications with the 8085ò, Penram International Pub.
2. M. A. Mazidi, J. G. Mazidi and R. D. McKinley : ñThe 8051 Microcontroller and Embedded Systems using Assembly and Cò, Pearson Education (2nd Ed.)
3. Furber: ñARM System on Chip Architecureò, 2nd Edition, Person India

References:

1. K. J. Ayala : ñThe 8051 Microcontrollerò, 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.

	Subject: CONTROL SYSTEM	L
Unit-1	**Basics of Control system** Types of control systems Classification of control system, Mathematical modeling of Physical Systems, Electrical Analogous Systems, Force -voltage analogy, force- Current analogy.	5
Unit-2	**Control system Representation** Block diagram reduction technique, rules for block diagram reduction. Analysis of multiple input multiple output systems, properties of signal flow graphs, Masonôs gain formula basic control actions.	6
Unit-3	**Time Response Analysis:** 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
Unit-4	**Stability of Control System:** 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
Unit-5	**Frequency- Domain analysis:** 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
Unit-6	**State Variable Analysis:** 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
	Total	**36**

Text Books:

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

References:

1. Richard C. Dorf and Robert H. Bishop, ñModern Control Systemsò, 11th Ed., Pearson Education.
2. M. Gopal, ñControl System ï Principles and Designò, Tata McGraw Hill, 4th Edition, 2012.
3. Norman S. Nise, ñControl System Engineeringò, 5th Edition, Wiley.
4. Bhattarcharya: Control System Engineering, 2nd Edition (Pearson Education).
5. Benjamin C. Kuo , Automatic Control System ñJOHN 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. Learndiscretesignalandsystemfundamentals.
2. Learn the discrete-time signals in the frequency domain, using Z-transform and DFT.
3. UnderstandtheimplementationoftheDFTintermsofthe FFT
4. LearnthebasicformsanddesignofFIRandIIR 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. Manipulatethediscretetimesignalsandidentifythetypesystem.
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. DesignFIRandIIRfilters.
5. Understand the concepts of Multirate Digital Signal Processing and need of Filter banks.
6. Understand the application of Digital Signal Processing

	Subject: DIGITAL SIGNAL PROCESSING	L
Unit-1	**Introduction to Discrete Time Signals[DTS]:** Discrete Time Signal, representations of DTS, Basic Signal Operations, Linear Convolution by using Analytical and Graphical Method.	6
Unit-2	**Z-Transform:** 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
Unit-3	**Discrete and Fast Fourier Transform:** 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
Unit-4	**Finite Impulse Response (FIR) filters:** Design techniques for FIR filter by windowing method: Rectangular window. Realization of basic structure FIR system: Direct form and Cascade.	5
Unit-5	**Infinite Impulse Response (IIR) filters:** 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
Unit-6	**Multirate Digital Signal Processing:** 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
	Total	**36**

Text Books:

1. Nagoorkani,ñDigital Signal Processingò,Tata McGraw-Hill Education, Second Edition.
2. S.Salivahanan, A.Vallavaraj,ñDigitalSignalProcessingò,TataMcGraw-HillEducation,2001.

References:

1. Oppenheim&Schafer,ñDiscretetimeProcessingò,PHI.
2. Proakis&ManolakisD.G.,ñDigital Signal Processingò,PHI.
3. MitraS.K.,ñDigital Signal Processingò, TMH.
4. Roman Kuc,ñDigital Signal Processingò, MGH.
5. IfeacherE.C.,JervisB.W.,ñDigital Signal Processingò,AddisonWesley.
6. P.P.Vaidyanathan,ñDSP and Multirate Systemsò, PHI.

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

Course Pre-Requisite:

1. 1B3Basic 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.

	Subject: POWER ELECTRONICS	L
Unit-1	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
Unit-2	Triac, Diac-construction, characteristics. power transistor, power MOSFET, IGBT - their construction & characteristics, Introduction to GTO, Classification of circuit for forced commutation.	7
Unit-3	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
Unit-4	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
Unit-5	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
Unit-6	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
	Total	**36**

Text Books:

1. M.D.Singh, K.B. Khanchandani, ñPower Electronicsò, Tata McGraw-Hill.
2. Muhammad H. Rashid, ñPower electronicsò Prentice Hall of India.

References:

1. Ned Mohan, Robbins, ñPower electronicsò, edition III, John Wiley and sons.
2. P.C. Sen., ñModern Power Electronicsò, edition II, Chand& Co.
3. V.R.Moorthi, ñPower Electronicsò, Oxford University Press.
4. Cyril W., Lander,ò Power Electronicsò, edition III, McGraw Hill.
5. G K Dubey, S R Doradla,: Thyristorised Power Controllersò, New Age International
6. Publishers. SCR manual from GE, USA.

5ETC04 Professional Elective - I (PE-I): (ii) FIBER OPTICS COMMUNICATION

Course Pre-Requisite:

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

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diode
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
5. To learn the fiber optical network components, variety of networking aspects, operational principles WDM.
6. To learn and understand the applications.

Course Outcomes:

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

1. Understand the principles fiber-optic communication, the components and Losses and dispersion in fiber.
2. Understand the properties of the optical fibers and optical components in sources.
3. Understand operation of lasers, LEDs, and detectors in fiber
4. Analyze system performance of optical communication systems in networks
5. Understand the block diagram of FOC System with Power budgeting parameters.
6. To apply the knowledge of fiber optical components, links, and systems.

	Subject: FIBER OPTICS COMMUNICATION	L
Unit-1	**Optical Fiber Communication System:** Basic optical laws and definitions, Optical fiber modes andconfigurations, N.A. Attenuation: Units, absorption, scattering losses radioactive losses, core and cladding losses.Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index.Material dispersion, wave guide dispersion, intermodal dispersion. [Numerical based on N.A. and mode calculations]	6
Unit-2	**Optical Sources:** Light Emitting Diodes: Structure, Light source materials. Laser Diodes: Structure, threshold conditions, Modulations of laser diodes. Light source linearity, reliability considerations.	6
Unit-3	**Optical Detectors:** Principles of photodiodes, Photo detector noise, Detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain.	6
Unit-4	**Optical switches** Coupled mode analysis of directional couplers, electro-optic-switches. Optical amplifiers - EDFA, Raman amplifier	6
Unit-5	WDM and DWDM systems. Principles of WDM networks. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solution based communication.	6
Unit-6	Block Diagram of fiber optic communication, selection of optical fiber types for short haul, long haul and high speed data links, optical power and dispersion budget calculations of fiber optic communication link, Repeaters, optical fiber amplifiers, optical fiber transmitter and optical fiber receiver design considerations. [Numerical are not expected]	6
	Total	**36**

Text Book: G. Keiser, ñOptical Fibre Communicationò, McGraw Hill International.

Reference:

1. Seniors J. M., ñOptical Fibre Communication and Applicationsò, 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	L
Unit-1	**Speech Production and Acoustic Phonetics:** 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 & audio processing	6
Unit-2	**Speech Analysis:** 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.	6
Unit-3	**Coding of Speech Signals:** Introduction, Quantization, Speech redundancies, Time domain waveform coding, Linear predictive coding: Linear Delta Modulation ,Adaptive Delta Modulation, Adaptive Differential Pulse Code Modulation	6
Unit-4	**Speech Synthesis:** Principles of speech synthesis, Articulatory synthesis, Formant synthesis and LPC synthesis.	6
Unit-5	**Speech Enhancement:** Introduction, Nature of interfering sounds, speech enhancement techniques: spectral subtraction and filtering, harmonic filtering, Spectral subtraction, Adaptive noise cancellation	6
Unit-6	**Speech Recognition:** Introduction, Bayeôs rule, Segmental feature extraction, MFCC, DTW, HMM approaches for speech recognition	6
	Total	**36**

Text Books:

1. ñSpeech Communications: Human & Machineò, Douglas O'Shaughnessy, Universities Press.
2. ñDigital Processing of Speech Signalsò, Rabiner and Schafer, Prentice Hall, 1978.

References:

1. ñDiscrete-Time Speech Signal Processing: Principles and Practiceò, Thomas F. Quatieri,Publisher: Prentice Hall.
2. ñSpeech and Audio Signal Processing: Processing and Perception of Speech and Musicò,Nelson Morgan and Ben Gold, John Wiley & Sons.
3. ñSpeech Analysis Synthesis and Perceptionò, J. L. Flanagan, Second edition, Springer-Verlag(1972).
4. ñSpeech and Audio Signal Processingò, 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

	Subject: SENSORS AND TRANSDUCERS	L
Unit-1	**Sensor & Transducers:** 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
Unit-2	**Characteristic, parameters and Errors** Characteristics of instruments ï static characteristics, Statistical Parameters with numericals. Error and its Types: Gross error, Systematic Error, Random Error with remedies.	6
Unit-3	**Temperature Measurement:** Introduction to Thermistor, RTD, Thermocouple and LM 335,Total Radiation Pyrometer **Velocity Measurement:** Velocity measurement system by encoder, Magnetic Pickup and Photo detector (Linear and Angular Measurement)	6
Unit-4	**Measurement of Displacement:** Resistive, Inductive (LVDT), Capacitive Methods **Humidity Measurement:** Resistive, Capacitive, Piezoelectric, and Infrared	6
Unit-5	**Measurement of Pressure:** 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. **Measurement of Flow:** Hot wire anemometer **Measurement of Level:** Resistive method, Ultrasonic level detector	6
Unit-6	**Strain Measurement:** Introduction, types of strain gauge, gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensationand applications of strain gauges. **Introduction to smart sensors**: Objective, block diagram, advantages and disadvantages.	6
	Total	**36**

Text Books:

1. Sawney A K and Puneet Sawney, ñA Course in mechanical measurements and instrumentation and controlò, 12th edition, DhanpatRai 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.

	Subject: DATA STRUCTURE	L
Unit-1	**Introduction and Overview** 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
Unit-2	**Linked List:** 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
Unit-3	**Stacks, Queues and Its Applications:** 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
Unit-4	**Tree** 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; Huffmanôs Algorithm. General trees.	6
Unit-5	**Graph and Their Applications** Introduction, Graph Theory Terminology, Sequential Representation of Graphs; Adjacency Matrix; Path Matrix, Warshallôs Algorithm; Shortest Paths, Linked Representation of Graph, Traversal algorithms, Operations on Graph, BFS, DFS, Spanning Trees	6
Unit-6	**Sorting And Hashing** Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Radix Sort, Performance and Complexity Analysis of various Sorting Methods, Hashing.	6
	Total	**36**

Text Books:

1. ñIntroduction to data structures with Cò by Seymour lipschutz.
2. Fundamentals of Data Structuresò, Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.

References:

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

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.

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

Text Books:

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

References:

1. Kathy Sierra & Bert Bates, ñHead First Javaò, OôREILLY
2. E Balagurusamy, ñProgramming with JAVA, A Primerò, Third Edition, TMH

5ETC06- MICROCONTROLLER- LAB

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

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

5ETC07- DIGITAL SIGNAL PROCESSING LAB

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

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

5ETC08- POWER ELECTRONICS LAB

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

Å 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) Vthsemester : Indian Constitution

(b) VIthsemester : 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.

	Subject: 6ETC01 COMMUNICATION NETWORK	L
Unit-1	**Data Communication Network:** 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. **Types of Network:** LAN, MAN, WAN. Network connecting Devices: Hubs, Repeater, Bridges, Switches, Routers, Gateways. **Network Topology:** Mesh, Bus, Tree, Ring, Star.	8
Unit-2	**Data Link Control Protocols:** 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
Unit-3	**Multiple Access Control Protocols:** Random Access Techniques: ALOHA, Slotted ALOHA, Contention Techniques: CSMA, CSMA/ CD (IEEE 802.3), CSMA/CA.Controlled Access Techniques: Polling, Token Passing. **Medium Access Control Protocols:** Token Bus (IEEE 802.4), Token Ring (IEEE 802.5).	6
Unit-4	**Network layer:** TCP IP Reference Model, IPv4-Classful and Classless Addressing, Virtual circuit and Datagram networks, Router, Routing algorithms, Dijkstraôs Algorithm (Problems expected), Bellman Ford Algorithm (Problems expected). Traffic Control: Leaky bucket algorithm, Token bucket algorithm.	5
Unit-5	**Transport layer:** Connectionless transport - UDP, Connection-oriented transport ï TCP, Remote Procedure Call. **Congestion Control and Resource Allocation:** Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.	5
Unit-6	**Application Layer:** Domain Name Space (DNS), TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP.	6
	Total	**36**

Text Books:

1. B. Forouzan, ñData Communications and Networkingò, 4th Edition, McGraw-Hill.
2. Andrew S. Tanenbaum and David J. Wetherall, ñComputer Networksò, 5th Edition, Pearson Education, Inc.
3. William Stallings, ñData and Computer Communicationò, 8th Edition, Pearson Education, Inc.

References:

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

	Subject: 6ETC02: COMPUTER ARCHITECTURE	L
Unit-1	**Basic Structure of Computers:** 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
Unit-2	**Processing Unit:** Processor organization, information representation, number formats, Instruction sets and its implementation. Arithmetic operation, ALU design, Floating point arithmetic, IEEE 754 floating point formats.	6
Unit-3	**Control Unit:** Micro operation, control of processor Hardwired implementation, micro program control: Concepts, microinstructions sequencing and execution, application of microprogramming.	6
Unit-4	**Memory Unit :**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
Unit-5	**I/O Organization :** Accessing I/O devices, Interrupts, Enabling and disabling interrupts, handling multiple devices, DMA, I/O Hardware, Standard I/O interfaces.	5
Unit-6	**Parallel Processing:** Basic concepts, types of parallel processors. Pipeline processor: Pipeline types, design, structures, Multiprocessors: Types, performance, parallel programming, Multiprocessor Architecture, interconnect network	6
	Total	**36**

Text Books:

1. Hayes J.P, ñComputer Architecture and Organizationò, PHI, Second edition
2. A.S.Tanenbum, ñStructured Computer Organizationò, PHI, Third edition
3. M.M.Mano, ñComputer System Architectureò, Edition

References:

1. V.Carl Hammacher, ñComputer Organisationò, Fifth Edition
2. Y.Chu, "Computer Organization and Microprogrammingò, II, Englewood Chiffs, N.J., Prentice Hall Edition
3. C.W.Gear, ñComputer Organization and Programmingò, 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

		L
	Subject: CMOS Design	
Unit-1	**BCMOS Device Fundamentals:** Mooreôs 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
Unit-2	**VLSI Circuit Design Processes:** VLSI Design Flow, CMOS Process enhancements ï 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
Unit-3	**CMOS Performance Parameter:** Introduction to Delays in CMOS,RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.	6
Unit-4	**Combinational Circuit Design:** CMOS logic families, CMOS logic gates design, Complex CMOS circuit, Transmission gate, Pass transistor logic.	5
Unit-5	**Sequential Circuit Design:** Design of latches and Flip-flops, Static Read - Write Memory (SRAM) Circuits (6T), Dynamic Read-Write Memory (DRAM) Circuits (3T).	5
Unit-6	**CMOS Clocking Styles:** CMOS Clocking Styles, Clocks Skew, Clock distribution techniques, Clock Jitter. **Dynamic Logic Circuit:** Dynamic Pass transistor logic, Dynamic CMOS logic, Domino logic, NORA logic.	6
	Total	**36**

Text Books:

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

References:
1. S.K. Ghandhi, ñVLSI Fabrication Principlesò, John Wiley Inc., New York, 1994 (2nd Edition).
2. Plummer, Deal, Griffin, ñSilicon VLSI Technology: Fundamentals, Practice &Modelingò PH, 2001.
3. S.M. Sze (Ed), ñVLSI Technologyò, 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. Toknowthebasicsoforbitalmechanism,thetypesof satelliteorbitsandorbitalaspectsof Satellitecommunication.
3. To understand the various typical phenomenon in satellitecommunication.
4. To understand different satellite channel parameters.
5. To understand the working of different satellitesubsystems
6. To understand the various services ofsatellite.

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. Visualizethearchitectureof satellitesystems as ameansof highspeed,highrange communicationsystem.
2. Statevariousaspectsrelatedtosatellitesystemssuchas orbitalequations,sub-systemsin asatellite
3. Solvenumerical problemsrelatedtoorbitalmotionanddesignoflinkbudgetforthe given parametersandconditions.
4. Learnadvancedtechniquesandregulatoryaspectsofsatellitecommunication
5. Understand role of satellite in variousapplications
6. Understand VSAT and GPS

	Subject: Satellite Communication	L
Unit-1	**Introduction to Satellite Communication:** Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication, satellite types ï LEO, MEO, GEO, HEO.	6
Unit-2	**Orbital Mechanics:** 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
Unit-3	**Typical Phenomena in Satellite Communication :**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
Unit-4	**Satellite Channels:** 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
Unit-5	**Satellite sub-systems:** 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
Unit-6	**Very Small Aperture Satellite (VSAT):** 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. **Satellite Navigation and Global Positioning System (GPS):** 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
	Total	**36**

Text Books:

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

Reference: Dennis Roddy: Satellite Communication: 4th 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 LeastSquare 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.

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

Text Books:

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

References:
1. "Adaptive Filtering Primer with MATLAB", Alexander D.Poulanikas & Zayed M Ramadan, Taylor & Francis Series, CRS Press.
2. "Adaptive Signal Processing", Bernard Widrow, Prentice-HallSignal Processing Series.
3. ."Real Time Digital Signal Processing: Implementation and Applications", Sen M. Kuo, Bob H. Lee and Wenshun Tian,2nd Ed, John Wiley & Sons, 2006.
4. "Adaptive Digital Filters", Maurice G Bellanger, 2nd Edition,
5. "Adaptive Nonlinear System Identification", Marcel DekkarInc. T Ogunfummi, Springer

6ETC04 Open Elective - II (OE-II): (i) INTRODUCTION TO PYTHON PROGRAMMING

Course Pre-Requisite:
1. (3ETC05) Object Oriented Programming

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings functions.
3. Illustrate the process of structuring the data using Lists, Tuples, Sets and Dictionary.
4. Indicate the use of regular expressions and built-in functions to navigate the file system.
5. To understand steps involved in Python to Mongo DB communication.

Course Outcomes:

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

1. Interpret the fundamental Python syntax and semantics
2. Be fluent in the use of Python control flow statements
3. Perform basic CURD operations on Mongo DB using Python.
4. Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, tuples and sets.
5. Identify the commonly used operations involving file systems and regular expressions.
6. To learn and use operators

	Subject: INTRODUCTION TO PYTHON PROGRAMMING	L
Unit-1	**Parts of Python Programming Language:**What is Python?, Features of Python, Identifiers, Keywords, Statements and Expressions, Variables, Data Types, Constants, Escape characters, Comments	6
Unit-2	**Operators:** Arithmetic Operators, Assignment Operators, comparison Operators, Logical Operators, Bitwise Operators, Membership Operator, Precedence and Associativity.	6
Unit-3	**Control Flow Statements:** Conditional statements: if, if-else, if-elif-else, Iterative statements: for, while Loops, Transfer statements: break, continue, pass.	6
Unit-4	**Tuples, Sets and Dictionaries:** List:Creation of List Objects, List Methods, Tuples: Creation of Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Sets: Sets Set Methods, Dictionary : Creation of Dictionary, Accessing, Modifying and Deleting Elements.	6
Unit-5	**Functions:** Built in Functions,User Defined Functions, Types of Arguments: Positional Arguments, Keyword Arguments, Default Arguments, Variable Length Arguments, Lambda expressions..	6
Unit-6	**Object Oriented Programming, MongoDB with Python3:** Classes and Objects, Creating Classes in Python, Creating Objects in Python, Mongo DB with Python3: Introduction to Mongo DB, use of pymongo, Steps in Python to MongoDB communication, Basic *CRUD* Operations.	6
	Total	**36**

Text Book:
1. Gowrishankar S, Veena A, **"Introduction to Python Programming",** 1st Edition, CRC Press/Taylor & Francis, 2019. ISBN-13: 978-0815394372

References:

1. Martin C. Brown, ñPython: The Complete Referenceò, Mc-Graw Hill Education (India) Edition 2018, New York
2. Niall O'Higgins, "MongoDB and Python", Oõ Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, ISBN: 9781449310370.
3. Yashavant Kanetkar, Aditya Kanetkar, ñLet Us Pythonò, bpb publication, 3rd Edition Dec.2020, ISBN : 9789389898521
4. R. Nageswara Rao, ñCore Python Programmingò, Dreamtech Press; 2nd edition, ISBN : 978-9386052308.
5. Paul Barry, :Head-First Python: A Brain-Friendly Guideò (2nd Edition), Shroff Publishers, ISBN: 9789352134823.

6ETC04 Open Elective - II (OE-II): (ii) DATABASE MANAGEMENT SYSTEM

Course Pre-Requisite: None

Course Objectives:

1. Basic knowledge of file structure and Data Base.
2. Knowledge of Entity Relation Diagram and data Modeling.
3. The basic knowledge of SQL query and structure.
4. The process of building normalization and apply to the database system.
5. Gaining the knowledge of transaction which applied on database.
6. Understanding the issues of concurrency and dead lock control.

Course Outcomes:

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

1. Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
2. Define the terminology, features, classifications, and characteristics embodied in database systems.
3. Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.
4. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
5. Understand the basic issues of transaction processing
6. Understanding the basic issues of concurrency control and dead lock in database.

	Subject: DATABASE MANAGEMENT SYSTEM	L
Unit-1	**Introduction to Database Systems:** Database System Applications, Database Systems versus File Systems, View of Data, Data Models, Transaction Management, Database System Structure, Application architectures. Entity Relationship Model, Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R Features, Design of an E-R Database Schema	6
Unit-2	**Data modelling using ER model (Entity Relationship Model):** Relational Model: Structure of Relational Databases, The Relational Algebra, Extended Relational-Algebra Operations, Modification of the Database, Views, The Tuple Relational Calculus, The Domain Relational Calculus.	6
Unit-3	**SQL Structure:** SQL: Basic Structure, Set Operations, Aggregate Functions, Null Values, Nested Subqueries, Views. Integrity and Security, Domain Constraints, Referential Integrity, Assertions, Triggers, Security and Authorization, Authorization in SQL	6
Unit-4	**Normalization:** Purpose of Normalization, Data Redundancy and Anomalies, Non-Loss decomposition and Functional Dependencies, First, Second and Third Normal Forms, Boyce/Codd Normal Form (BCNF)	6
Unit-5	**Transaction Processing:** The Concept of Transaction, States of Transaction, Concurrent Execution of Multiple Transactions, Serializability - Conflict and View Serializability	6
Unit-6	**Concurrency Control and Dead Lock: Concurrency Control and Deadlock Recovery:** Lock Based Protocols - Two Phase Locking Protocol and Time Stamp Based Protocol, Types of Locks, Deadlock Handling - Deadlock Detection, Deadlock Recovery, Deadlock Prevention	6
	Total	**36**

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

References:

1. Raghu Ramkrishnan :ò Database Systemò. McGraw Hill
2. C.J.Date : ñDatabase Systemò, 7th ed. (Pearson Education)
3. Connolly &Begg, : Database System,Low Price Ed.
4. Nawathe& Al-Masseri ñ Database Systemsò (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
Unit-1	**Solar Cell Fundamentals and Solar Resource** 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
Unit-2	**Solar Cell Technologies** 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
Unit-3	**Solar Photovoltaic Systems and Applications** 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
Unit-4	**Introduction to Hybrid Electric Vehicle** Review of Conventional Vehicle: Introduction to Hybrid Electric Vehicles: Electric Vehicle Evolution, Types of EVs, Types of battery for EVs.	6
Unit-5	**Electric Drives:** 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.	6
Unit-6	**Energy Storage:** 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.	6
	Total	**36**

Text Books:

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

References:

1. G. M. Masters, ñRenewable and Efficient Electric Power Systemsò, John Wiley and Sons, 2004.
2. J. A. Duffie and W. A. Beckman, ñSolar Engineering of Thermal Processesò, John Wiley & Sons, 1991
3. B.H. Khan, ñNon-Conventional Energy Resourcesò, McGraw Hill 2nd Edition 2017.
4. Emadi, A. (Ed.), Miller, J., Ehsani, M., ñVehicular Electric Power Systemsò Boca Raton, CRC Press, 2003
5. Husain, I. ñElectric and Hybrid Vehiclesò Boca Raton, CRC Press, 2010.
6. Larminie, James, and John Lowry, ñElectric Vehicle Technology Explainedò 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

	Subject: 6ETC05: ENGINEERING ECONOMICS	L
Unit-1	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
Unit-2	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
Unit-3	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
Unit-4	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
Unit-5	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
Unit-6	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 Pythonmust be conducted.
- Course Objectives and Course Outcomes shall be specified based on the experiments conducted

6ETC09: MINI PROJECT

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

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 individualôs 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 individualôs 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) Vth semester : Indian Constitution

(b) VIth semester : Indian Traditional Knowledge

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NOTIFICATION

No. 65 /2022 Date : 18/06/2022

Subject : Implementation of new Syllabi of Semester VII & VIII of B.E. (Electronics & Telecommunication Engg.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum…

It is notified for general information of all concerned that the authorities of the University have accepted to implement new Syllabi of **Semester VII & VIII of B.E. (Electronics & Telecommunication Engg.) (C.B.C.S.)** as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2022-23 onwards as per ñ**Appendix – A**ò as given below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

ñ**Appendix A**ò

SYLLABUS OF B.E. SEM. VII & VIII (ELECTR0NICS & TELECOMMUNICATION ENGINEERING) [C.B.C.S.]

SEMESTER VII
7ETC01: MICROWAVE THEORY AND TECHNIQUES

Course Requisite: (3ETC04) Electromagnetic Waves

Course Objectives: To learn:

1. Basic concepts of Microwave active and passive devices.
2. Operations of Semiconductor Microwave Devices.
3. Transmission characteristic of microwave through waveguide and parallel microstrip line.
4. Operations of Microwave resonators
5. S-parameters for characterization of microwave devices
6. Measurement of microwave parameters.

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

1. Understand operations of microwave active and passive devices.
2. Understand operations of Semiconductor Microwave Devices.
3. Describe characteristics of microwave propagation through waveguide and parallel microstrip line
4. Understand Operations of Microwave resonators.
5. Use S-parameters for characterization of microwave devices.
6. Measure various parameters of microwave system.

Unit-I: Introduction to Microwaves: History of Microwaves, Microwave Frequency bands; Applications of Microwaves, Microwave Tubes: Limitation of Conventional devices at high frequency, Construction & working principle with supportive expressions of Two cavity, Reflex klystron, Cylindrical Cavity Magnetron & TWT. (7)

Unit-II: Semiconductor Microwave Devices: Construction & working of Gunn Diodes, IMPATT diodes, TRAPAT diodes & Parametric amplifiers and MASERs. (5)

Unit-III: Waveguide system and Microstrip line: Waveguides: Introduction, TE & TM Modes of propagation through rectangular wave guide & circular waveguide, Microstrip line: Introduction, characteristic impedance & losses in parallel microstrip line. (8)

Unit-IV: Microwave Resonator: Transmission line resonators, Cavity resonators: rectangular and circular cavities, resonant frequency, and quality factor of resonators. (6)

Unit-V: Passive Microwave Devices: Scattering matrix formulation for E-plane tee, H-plane tee , Magic Tee, Directional Coupler, Principle of Faradayôs rotation, Isolator, Gyrator & Circulator. (6)

Unit-VI: Microwave Measurements: Frequency Measurements, Power Measurements, Attenuation Measurements, VSWR Measurements, Impedance Measurements, Noise at microwave frequency and measurement of noise figure. (4)

Text Books:

1. Liao, Samuel Y., ñMicrowave Devices & Circuitsò, Tata Mc-Graw Hill Co. Ltd., New Delhi. 2
2. David M Pozar, ñMicrowave Engineeringò Wiely 3 rd Edition.
3. Collin, Robert E., ñFoundations for Microwave Engineeringò, Mc- Graw Hill, New York.

Reference Books:

1. Kennedy G., ñElectronics Communication Systemsò, Tata Mc-Graw Hill Book Co.,New Delhi..
2. K.C. Gupta, ñMicrowave Engineeringò, New Age.
3. Reich, Scolnik, Ordung, Krangs, ñMicrowave Principlesò, PHI.
4. M.L. Sisodiya and G.S. Raghuwanshi, ñMicrowave Circuits and Passive devicesò, John Wiley & Sons Ltd.
5. Mathew M. Radmanesh, ñRF and Microwave Electronics ï Illustratedò, Prentice Hall.

7ETC02: DIGITAL IMAGE AND VIDEO PROCESSING

Course Requisite:

1. Signals and Systems. (4ETC04)
2. Digital Signal Processing (5ETC03)

Course Objectives:

After taking this course student will be capable to learn and apply:

1. Fundamentals of digital image processing
2. Digital image filtering techniques in spatial and frequency domain.
3. Knowledge of image transform and enhancement techniques in digital image processing
4. Various image compression techniques used in digital image processing.
5. Fundamentals of Video Processing and segmentation.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Comprehend fundamentals of digital image processing.
2. Understand & apply knowledge of spatial domain and frequency domain filtering to digital images.
3. Analysis of image segmentation and morphological techniques.
4. Understand image degradation model and its restoration; analyze various image compression techniques based on redundancy features.
5. Understand the Fundamentals of digital video processing.
6. Comprehend motion estimation and video processing applications.

Unit-I: Digital Image Fundamentals: Elements of visual perception, image as a 2-D signal, image sensing and acquisition, image sampling and quantization, image formats, image types, basic relationships between pixels neighborhood, adjacency, connectivity, distance measures. (6)

Unit-II: Image Enhancements and Filtering in Spatial and Frequency domain: Gray level transformations, histogram equalization and specifications, spatial-domain smoothing filters ï linear and order-statistics, spatial-domain sharpening filters: first and second derivative, two-dimensional DFT and its inverse, frequency domain filters low-pass and high-pass. (6)

Unit-III : Image Segmentation and Image morphological techniques: Detection of discontinuities, Thresholding : local and global, region-based segmentation, edge and boundary detection techniques using laplace, guassian and high pass filtering, Basic morphological image processing concepts, Basic concepts of erosion and dilation, The Hit-or-Miss Transformation. (6)

Unit –IV: Image restoration and Compression techniques.: Image degradation and restoration technique (Wiener filtering), Image Compression Redundancyï inter-pixel, psycho-visual and coding, entropy, Loss less compression (Huffman and Lempel-Ziv), Lossy compression- predictive and transform coding; Still image compression standards ï JPEG and JPEG-2000. (6)

Unit-V: Fundamentals of Video Processing : Time-Varying Image Formation model, fundamentals of Three-Dimensional Motion Model, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals in spatial domain**,** formats of video signals**.** (6)

Unit-VI: Applications of digital video processing: Motion estimation using pixel based, block matching and mesh based**,** Application of motion estimation in video coding, Fundamentals of Temporal segmentation, Video object detection and tracking. (6)

Text Books:

1. Gonzaleze and Woods ,òDigital Image Processing ñ, 3rd edition , Pearson
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar,òDigital Image Processing ñ, 2nd edition, McGraw Hill publication
3. M. Tekalp ,òDigital video Processingò, Prentice Hall International
4. Yao wang, Joem Ostarmann and Ya ï quin Zhang, òVideo processing and communication ñ, 1st edition , PHI

Reference Books:

1. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
2. Arthur R. Weeks, ñFundamentals of Electronic Image Processingò, Wileyï Blackwell
3. Wiliam Pratt,ò Digital Image Processing: PIKS Inside, Fourth Editionò, A Wiley-Interscience Publication

7ETC03 PROJECT MANAGEMENT & ENTREPRENEURSHIP

Course requisite: 6ETC05 Economics for Engineers:

Course Objectives:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Outcomes:

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

1. Understand basic concept of Project management
2. Attain the knowledge of cost estimation & working capital
3. Prepare Cost Sheets, balance sheets and Cash Flow statements
4. Understand the Entrepreneurial competencies & traits
5. Discuss the Management skills for Entrepreneurs
6. Understand Social Entrepreneurship

Unit-I: Project Management: Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal,; Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal. (6)

Unit-II: Project Financing: Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation. (6)

Unit-III: Project Report and Finance: preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance. (6)

Unit-IV: Entrepreneurship: Entrepreneurship: need, scope, Entrepreneurialcompetencies & traits, Factors affecting entrepreneurial development,Entrepreneurial motivation (Mc Clellendôs Achievement motivationtheory), conceptual model of entrepreneurship, Entrepreneur vs.Entrepreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes. (6)

Unit-V: Entrepreneurial Idea and Innovation: Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities,Management skills for Entrepreneurs and managing for Value Creation,Creating and Sustaining Enterprising Model & Organizational Effectiveness. (6)

Unit-VI: Social Entrepreneurship: Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures. (6)

Text Books:

1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
2. Business, Entrepreneurship and Management: Rao, V.S.P.; Vikas

Reference Books:

1. Entrepreneurship: Roy Rajeev; OUP.
2. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.;McMillan
3. Project Management for Engineering, Business and Technology: Nicholas, J.M., andSteyn, PHI

7ETC04 PROFESSIONAL ELECTIVE - III (PE-III)
(i) HIGH SPEED ELECTRONICS

Course Requisite: 4ETC02 Analog Circuits

Course Objectives: To learn:

1. Basic concepts of the active and passive devices.
2. Basics of non-ideal interconnect issues.
3. The PCB making design concepts.

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

1. Explain significance and the areas of application of high-speed electronics circuits.
2. Analyze effect of noise in high speed application
3. Summarize the properties of various components used in high speed electronics
4. Design the various type of RF amplifier for high speed application
5. Explain the operation of the Mixer, Oscillator and PLL transceiver
6. Design the various types of PCB using CAD tool

Unit-I: Transmission line theory (basics): The Importance of Interconnect Design, Transmission Line Structures, Wave Propagation, Transmission Line Parameters, Transmission Line Reflections, Termination Schemes to Eliminate Reflections, Multiple Reflections, Crosstalk, Crosstalk Estimation, Crosstalk Termination Schemes. (6)

Unit-II: Basics of Non ideal Interconnect Issues, Transmission Line Losses, Concentric-Ring Skin-Effect Model, Serpentine Traces. Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Inter modulation, Cross-modulation, Dynamic range. (6)

Unit-III: Buffer Modeling, Types of Models, CMOS Output Buffer, Digital Timing Analysis, Common-Clock Timing, Source Synchronous Timing, Clock Repeaters, Zero-Delay Clock Repeaters, Clock Jitter. (6)

Unit-IV: Devices: Passive and active, Lumped passive devices (models), Active (models, low vs. high frequency). (6)

Unit-V: RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations. (6)

Unit VI: Printed Circuit Board: Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design Challenges. (6)

Text Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall ñHigh-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practicesò, August 2000, Wiley-IEEE Press
2. Thomas H. Lee, ñThe Design of CMOS Radio-Frequency Integrated Circuitsò, Cambridge University Press, 2004, ISBN 0521835399.
3. Behzad Razavi, ñRF Microelectronicsò, Prentice-Hall 1998, ISBN 0-13-887571-5.

Reference Books:

1. Guillermo Gonzalez, ñMicrowave Transistor Amplifiersò, 2nd Edition, Prentice Hall.
2. Kai Chang, ñRF and Microwave Wireless systemsò, Wiley.
3. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011.
4. Chris Schroeder , ñPCB Design Using AutoCADò 1st Edition, 1997.

7ETC04 PROFESSIONAL ELECTIVE - III (PE-III)
(ii) MOBILE COMMUNICATION AND NETWORKS

Course Requisite: 4ETC01 Analog and Digital Communication.

Course Objectives:

1. To know the evolution of Mobile communication and cell concept to improve capacity of the system.
2. To know the role of equalization in Mobile communication and to study different types of Equalizers and Diversity techniques.
3. To understand the concepts of orthogonal frequency division multiplexing.

Course Outcomes:

After completing the course, the students will be able to:

1. Explain basic concept of Cellular systems and standards
2. Demonstrate knowledge of Signal propagation model
3. Compare different multiple access techniques in mobile communication.
4. Summarise the concept of rake receiver
5. Demonstrate advance knowledge of MIMO
6. Compare different Mobile Communication Systems and standards

Unit-I: Cellular concepts: Evolution of Mobile Radio Communication Systems, 1G, 2G, 2.5G, and 3G Wireless Cellular Networks and Standards, Cell structure, frequency reuse, cell splitting and sectoring, Channel assignment, concept of handoff, Interference (both Adjacent Channel and Co-Channel), capacity, power control mechanisms. (7)

Unit-II : Signal propagation-Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Small Scale Fading and Multipath Propagation, Types of Small-Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread. (7)

Unit-III: Multiple access schemes-Multiple access techniques in wireless communication: FDMA TDMA, CDMA, SDMA and Hybrid, Introduction of OFDM techniques. (5)

Unit-IV: Receiver Structure- Diversity receivers- selection and MRC receivers, RAKE receiver, Equalization: Linear and Adaptive, Algorithms for adaptive equalization, space, polarization, frequency diversity, Interleaving. (6)

Unit-: MIMO Channels: Physical modelling, MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. (5)

Unit-VI: Mobile Systems - GSM, GPRS, CDMA 2000 and WCDMA, LTE, Introduction to Cognitive Radio, Introduction to 5G. (6)

Text Books:

1. T.S.Rappaport, ñWireless Communications Principles and Practiceò, 2nd edition, PHI, 2002.
2. William C.Y.Lee, ñMobile Cellular Telecommunications Analog and Digital Systemsò, 2nd edition, TMH, 1995. Asha Mehrotra, ñA GSM system Engineeringò Artech House Publishers Bosten, London,1997
3. V.K.Garg, J.E.Wilkes, ñPrinciple and Application of GSMò, Pearson Education, 5th edition, 2008.
4. V.K.Garg, ñIS-95 CDMA & CDMA 2000ò, Pearson Education, 4th edition, 2009.

Reference Books:

1. D. Tse and P. Viswanath, Fundamentals of Wireless Communication, Cambridge Univ. Press, 2005.
2. A. Goldsmith, Wireless Communications, Cambridge Univ. Press, 2005.
3. A. Kumar, D. Manjunath, and J. Kuri, Wireless Networking, Morgan Kaufmann, 2008.

7ETC04 PROFESSIONAL ELECTIVE - III (PE-III)
(iii) MIXED SIGNAL DESIGN

Course Requisite: 4ETC02 Analog Circuits.

Course Objectives: The student will understand the concepts of :

1. CMOS Process flow, basic MOSFET and op-amp circuits,
2. Switched capacitors Circuits
3. Phase lock loops
4. Data Converter fundamentals.
5. Nyquist Rate A/D Converters and applications
6. The Oversampling Converters and Continuous-Time Filters

Course outcomes: After successfully completing the course, the students will be able to:

1. Expand knowledge of the CMOS Process, and op-amp design
2. Devise appropriate switch capacitor circuits
3. Analyze phase lock loop circuits
4. Use desired data converters in various applications.
5. Explain Various types of A/D Converters
6. Understand D/A converters.

Unit-I: Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Basic Op-Amp Design. (6)

Unit-II: Switched Capacitor Circuits: Introduction to Switched Capacitor circuits basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, switched capacitor integrators, first order filters, Switch sharing. (6)

Unit-III: Phased Lock Loop (PLL): Basic PLL topology, Design and Analysis of various PLL blocks, Basic charge pump PLL, Non-ideal effects in PLLs, Design of FM detector circuit. (6)

Unit-IV: Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters-Decoder based converters, Binary-Scaled converters, Hybrid converters. (6)

Unit-V: Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time interleaved converters. (6)

Unit-VI: Oversampling Converters: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibit quantizers, Delta sigma D/A. (6)

Text Books:

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, Tata McGraw Hill, 2nd Edition.
2. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition.

Reference Books:

1. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.
2. CMOS Analog Circuit Design ï Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

7ETC05 PROFESSIONAL ELECTIVE - IV (PE-IV)
(i) INTRODUCTION TO MEMS

Course Requisite: 3ETC02 - Electronic Devices & Circuits

Course Objectives: The learners will-

1. Understand Scope, importance and application of MEMS
2. Distinguish materials for MEMS devices
3. Examine fundamental laws governing MEMS devices
4. Summarize MEMS design process.
5. Recommend MEMS sensors and actuators
6. Devise MEMS Applications.

Course Outcomes:
After successfully completing the course, the students will be able to:

1. Demonstrate skills to select appropriate material for MEMS devices
2. Understand fabrication process of MEMS
3. Select appropriate sensor and actuator in a given application.

Unit-I: Introduction: Historical background**,** classification, intrinsic characteristics of MEMS, miniaturization issues, microelectronic integration, precision parallel fabrication, scaling effects, future trends. (6)

Unit-II: MEMS Materials: Overview, Physical Properties, Materials: Piezoelectric, Electrostrictive, Magnetostrictive, Magneto-electric; Fluids: Magnetorheological and Electrorheological Fluids. (6)

Unit-III: Mechanics of solids in MEMS/NEMS: Stress, Strain, Hookesõs law, Poisson effect, Linear Thermal Expansion, Bending; Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems. (6)

Unit-IV: Review of Basic MEMS fabrication modules: Oxidation, deposition techniques, lithography (LIGA), Etching, Surface Micromachining, sacrificial layer processes, bulk micromachining, isotropic and anisotropic etching. (6)

Unit-V: MEMS Sensors and Actuation: Sensors and actuators consideration, Electrostatic Sensors, Micro Grippers, Micro Motors, Thermal Resistors, Thermal Bimorph , Piezoresistive Sensors, Pressure and flow Sensors. (6)

Unit-VI: Applications of MEMS : Electronics, automotive and medical; automotive airbag sensor, medical pressure sensor, blood Pressure Sensors, microphone, Bio-MEMS, acceleration sensing, gyros. (6)

Text Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, ñMicro and Smart Systemsò, Wiley India, 2012. 2.
2. S. E.Lyshevski, ñNano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineeringò (Vol. 8). CRC press, (2005).
3. S. D. Senturia, ñMicrosystem Designò, Kluwer Academic Publishers, 2001.

Reference Books:

1. Tai-Ran Hsu, ñMEMS and Microsystems Design and Manufactureò, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
2. Chang Liu, ñFoundations Of MEMSò, Pearson Education Inc., 2012.
3. Mark Madou, ñFundamentals of Microfabricationò, CRC Press, New York, 1997.

7ETC05 PROFESSIONAL ELECTIVE - IV (PE-IV)
(ii) ERROR CORRECTING CODES

Course Requisite: 4ETC01 Analog and Digital Communication

Course Objectives: After completing this course the students should be able to:

1. Understand Block Codes and Maximum Likelihood Decoding.
2. Understand Decoding Tables, Hamming Weight and Distance and Error Correction vs Detection.
3. Understand Generator Matrix, Parity-Check Matrix and Error-Correcting Capability of a Linear Code
4. Understand Binary Cyclic Codes, encoding with (n-k)-Stage Shift Register and Syndrome Calculations and Error Detection.
5. Understand Error Trapping Decoding for Cyclic Codes.
6. Understand BCH Codes and the encoding and decoding techniques.

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

1. Understand the error sources
2. Understand error control coding applied in digital communication
3. Able to transmit and store reliable data and detect errors in data through coding
4. Able to understand the designing of various codes like block codes, cyclic codes, convolution codes, turbo codes and space codes.

Unit-I: Error Control Coding: Introduction to Error Control Coding, Types of Errors, Methods of Controlling Errors, Linear Block Codes: Matrix Description of Linear Block codes, Hamming Distance, Hamming Weight, Minimum Hamming Distance, Hamming Codes. (6)

Unit-II: Linear block codes: Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Encoder for Linear Block code, Syndrome Decoding, Syndrome Decoder for (n, k) Linear Block Code, Error Detection and Correction capability of Linear Block Codes (Derivation expected). (7)

Unit-III: Cyclic Codes: Properties of Cyclic Codes, Systematic and Non-Systematic generator Matrix, Parity Check Matrices for Cyclic Codes, Encoders for Cyclic Codes, Syndrome Decoding for Cyclic Codes.
Introduction to Convolution Codes: Time Domain Approach and Transform domain approach for convolution code generation, Code Tree and Code Trellis for Convolution code. (6)

Unit-IV: Cyclic Codes. BCH codes; Reed-Solomon codes, MDS codes, Spectral properties of cyclic codes. ; Cyclic codes - Syndrome calculation, Encoder and decoder ï CRC. (6)

Unit-V: Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. (5)

Unit-V: A fast Berlekamp - Massey algorithm. Convolution codes; Wozencraft's sequential Decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm. **(6)**

Text Books:

1. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977.
2. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

Reference Books:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE
2. Digital Communications- John G. Proakis, 5th ed., 2008, TMH.

7ETC05 PROFESSIONAL ELECTIVE - IV (PE-IV)
(iii) ANTENNA AND PROPAGATION

Course Requisite: 3ETC04: Electromagnetic Waves.

Course Objectives: The student will learn and understand -

1. Basic terminology and concepts of Antennas.
2. Concept of radiation mechanism of various antennas and antenna array.
3. Principle of aperture antennas.
4. Concept of Broadband & Micro strip antennas.
5. Smart antenna environments & implementation.
6. Mechanism and models for radio-wave propagation

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

1. Describe the basic concepts and applications of Antenna systems.
2. Determine the radiation pattern and directivity of antenna arrays.
3. Describe the concept of Huygens Principle & Babinetôs Principle.
4. Understated the properties of broadband antennas and micro strip antennas.
5. Describe the basic principles of smart antenna systems.
6. Understand different ways of propagation of radio waves.

Unit-I: Antenna Fundamental: Concept of radiation, Radiation pattern, near-and far-fields, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation. (6)

Unit-II: Antenna Arrays: Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, small circular loop, Antenna array, Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays. (6)

Unit-III: Aperture Antennas: Huygensô Principle, radiation from rectangular and circular apertures, design considerations, Babinetôs principle, Radiation from sectoral and pyramidal horns, designconcepts, parabolic reflector and Cassegrain antennas. (6)

Unit-IV: Broadband & Micro strip Antennas: Broadband Antennas: Broadband concept, Log-periodic and Yagi-Uda antennas, frequency independent antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, Introduction of rectangular and circular patch antennas. (6)

Unit-V: Smart Antennas: Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. (6)

Unit-VI: Wave Propagation: Modes of Propagation: Ground, Sky & Space Wave Propagations, Structure of Atmosphere, Fading, ionospheric absorptions, Multi-hop propagation and Super refraction. (6)

Text Books:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons, 2005.
2. Harish A. R., Antenna and wave propagation, Oxford University Press. Tri T. Ha, ñDigital
3. Satellite Communicationsò, Tata McGraw-Hill,2009 J.D.Kraus,òAntennas,McGraw-Hill,1988
4. R.S.Elliot, ñAntenna Theory and Designò, IEEE Press, John Wiley, 2005,
5. K.D.Prasad, ñAntennas and Radiating Systemsò, Satyaprakasa

Reference Books:

1. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
2. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw hill, 1984.
3. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005.
5. R.E. Crompton, Adaptive Antennas, John Wiley.

7ETC06- MICROWAVE THEORY AND TECHNIQUES –LAB.

Minimum Eight Experiments based on syllabus of 7ETC01: Microwave Theory and Techniques must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

7ETC07- DIGITAL IMAGE AND VIDEO PROCESSING – LAB.

Minimum Eight Experiments based on syllabus of 7ETC02: Digital Image and Video Processing must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

7ETC08- PROJECT MANAGEMENT & ENTREPRENEURSHIP – LAB.

Minimum Eight Experiments based on syllabus of 7ETC03 Project Management and Entrepreneurship must be conducted. Course Objectives and Course Outcomes shall be specified based on the experiments conducted.

7ETC09- PROJECT STAGE-I (SEMINAR)

Seminar based on Final Year Major Project should be conducted with submission of Seminar Report as part of 7ETC09-Project Stage-I (Seminar).

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SEMESTER VIII

8ETC01: EMBEDDED SYSTEMS

Course Requisite:

1. (3ETC03) Digital System Design
2. (3ETC05) Object Oriented Programming
3. (5ETC01) Microcontroller

Course Objectives:

1. To study the concept of Embedded Systems
2. To understand core of the Embedded System
3. To study architecture and inbuilt peripherals of AVR Microcontroller
4. To know microcontroller C Language Programming concepts.
5. To recognize the importance task scheduling in real time embedded systems.
6. To get acquainted with architecture & design of an Embedded System.

Course Outcomes:
After successfully completing the course, the students will be able to,

1. Recognize the concept of Embedded Systems
2. Summarize the quality attributes of Embedded System
3. Articulate the architecture and inbuilt peripherals of AVR Microcontroller
4. Evaluate the programming of AVR Microcontroller in C
5. Compare task, process & threads in Real Time Embedded System
6. Assess validation and debugging of Embedded System

Unit-I ; Introduction to Embedded systems: History of Embedded system, Embedded systems vs. General computing systems, Classification of Embedded systems, Major application areas of Embedded systems, Purpose of Embedded systems. (6)

Unit –II: Building blocks of Embedded systems: Core of the Embedded system, Memory Devices, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System components, Characteristics of Embedded systems, Quality attributes of Embedded System. (6)

Unit-III: Introduction to AVR Microcontroller: AVR microcontroller, History, Features and AVR family and its inbuilt Peripherals, Architecture of ATMega 32: signal description, registers of AVR, Data Memory, data formats. (6)

Unit-IV: AVR Application and Programming in C: Data types, I/O programming, I2C, Timer Structure, Watch dog timer, UART, Interrupt Structure, Analog to Digital convertors. (6)

Unit-V: RTOS based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Processes and Scheduling. (6)

Unit-VI: Embedded System Architecture: Architecture Styles, implementation Aspects, validation & debugging of embedded systems, hardware ï software co-design in an embedded system. (6)

Text Books:

1. Introduction to Embedded System, Shibu K. V.,McGraw Hill Education
2. Embedded Real-time Systems Programming, S.V. Iyer & Pankaj Gupta, McGraw Hill Education
3. ñAVR Microcontroller and Embedded systems using assembly and Cò, Muhammad Ali Mazidi, Sarmad Naimi and Sephers Naimi, Pearson Education, Inc. publishing as Prentice Hall 2013.

Reference Books:

1. ñEmbedded Systemsò, Rajkamal, 2nd Edition, Tata McGraw Hill
2. ñScheduling in Real Time Systemsò, Cottet, Delacroix & Mammeri, John Wiley & Sons.

8ETC02: CRYPTOGRAPHY AND NETWORK SECURITY

Course Pre-requisites:

1. 4ETC04 : Signals and Systems
2. 5ETC03 : Digital Signal Processing
3. 6ETC01: Communication Network

Course Objectives:

1. Explain the objectives of information security
2. Explain the importance and application of each of confidentiality, integrity, authentication and availability
3. Understand various cryptographic algorithms.
4. Understand the basic categories of threats to computers and networks
5. Describe public-key cryptosystem.
6. Describe the enhancements made to IPv4 by IPSec

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

1. Understand basic cryptographic algorithms
2. Attain the knowledge of message and web authentication and security issues.
3. Identify information system requirements
4. Understand the current legal issues towards information security
5. Discuss the fundamental ideas of public-key cryptography
6. Understand Intrusions and intrusion detection.

Unit – I: Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks. (6)

Unit-II: Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. (6)

Unit-III: Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm. (6)

Unit-IV: Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public ï Key Infrastructure (6)

Unit-V: Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security. (6)

Unit-VI: E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability. (6)

Text Books:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH .
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning 6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(i) NANO ELECTRONICS

Course Prerequisite: 3ETC02: Electronics Devices and Circuits.

Course Objectives:

1. The course intends to give students a broad understanding of fundamentals, fabrication technologies and applications of nano scale structures.
2. Students will also be trained for literature study and critique, oral presentation, problem formulation, solution development, and formal writing.
3. To introduce the students to nano-electronics, nano-devices, spintronics and molecular electronics. To identify quantum mechanics behind nano-electronics.
4. To describe the principle and the operation of nano-electronic devices.
5. To explain the principle and application of spintronic devices.
6. To identify quantum mechanics behind nano-electronics.

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
5. Students will understand the divers electronic device fabrication.
6. Students will have in-depth technical knowledge in one or more areas of specialization.

Unit- I : Introduction: Recent past, the present and its challenges, Future, Overview of basic Nano electronics. Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig Penny Model. Brillouin Zones. (6)

Unit-II: Nano electronics & Nano computer architectures: Introduction to Nano computers, Nano computer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches, Interface engineering, Properties (Self-organization, Size-dependent) ï Limitations. (6)

Unit-III: Nano electronic Architectures: Nanofabrication, Nano patterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) ï Nano phase materials ï Self assembled Inorganic/Organic layers. (6)

Unit-IV: Spintronics: Introduction, Overview, History & Background, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors. (6)

Unit-V: Memory Devices and Sensors: Memory devices and sensors, Nano Ferroelectric random access memory, Fe-RAM circuit design, ferroelectric thin film properties and integration, calorimetric ï sensors, semiconductor sensor array. (6)

Unit-VI : Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.) (6)

Text Books:

1. Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998.
4. Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices, 2001.
5. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
6. K.E. Drexler, Nanosystems, Wiley, 1992.

Reference Books:

1. Nano Terchnology and Nano Electronics ï Materials, devices and measurement Techniques by WR Fahrner ï Springe
2. Nano: The Essentials ï Understanding Nano Scinece and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill.
3. Spin Electronics by M. Ziese and M.J. Thornton
4. Nanoelectronics and Nanosystems ï From Transistor to Molecular and Quantum Devices by Karl Goser, Peter Glosekotter, Jan Dienstuhl
5. Silicon Nanoelectronics by Shunri Odo and David Feny, CRC Press, Taylor & Franicd Group
6. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj, RSC Publishing
7. Quantum-Based Electronic Devices and Systems by M. Dutta and M.A. Stroscio, World Scientific. 8. James R Sheats and Bruce w.Smith, ñMicrolithography Science and Technologyò, Marcel Dekker Inc., New York, 1998.
8. J.P. Hirth and G.M.Pound ñEvaporation: Nucleation and Growth Kineticsò Pergamon Press, Oxford, 1963.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(ii) WIRELESS SENSOR NETWORKS

Course Requisite: 7ETC04: Mobile Communication and Networks.

Course Objectives:

1. Basic concepts of Wireless Sensor Networks
2. Architecture details of WSN
3. Case study of the WSN.

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand the basis of Sensors with its applications
2. To learn the architecture and placement strategies of Sensors
3. To analyze routing and congestion algorithms
4. To design, develop , and carry out performance analysis of sensors on specific applications
5. To explore and implement solutions to real world problems using sensor devices, enumerating its principles of working
6. To understand the working through the case study on WSN.

Unit-I: Introduction to wireless sensor Networks ï Advantages of ad-hoc/sensor networks, Unique constraints and challenges-. Applications Platforms for WSN: Sensor node hardware: mica2, micaZ, telosB, cricket, Imote2, tmote, btnode . Sensor node software introduction (Operating System): tiny0S, MANTIS, Contiki, and Ret0S. (7)

Unit-II: Single-Node Architecture. WSN coverage and placement: Coverage problems in WSN ï Type of coverage ï OGDC coverage Algorithm- Placement Problem. (6)

Unit-III: Topology management in wireless sensor Networks-: Different classification of topology management Algorithms-topology discovery-sleep cycle management. Medium access control in wireless networks. (6)

Unit-IV: Routing in sensor networks: Data centric- position based routing- data aggregation- Clustered based routing Algorithms. (5)

Unit-V: Congestion and flow control: Source of congestion- congestion control scenarios- Protocols for congestion and flow control in sensor networks: ESRT-CODA-PSFQ-RCRT-RMST-Fusion. (6)

Unit-VI: Hard ware design of sensor Networks : Characteristics ï Design challenges- Design of Architecture- Functional components- Energy supply- operating system. Application: Home Control, Highway Monitoring, Environmental Engineering Applications. (6)

Test Books:

1. Holger Karl and Andreas Willig, ñProtocols and Architectures for Wireless Sensor Networksò, John Wiley & Sons, 2005.
2. Zhao and L. Guibas, ñWireless Sensor Networksò, Morgan Kaufmann, San Francisco, 2004
3. C. S. Raghavendra, K.M.Shivalingam and T.Znati, ñWireless Sensor Networksò, Springer, New York, 2004

Reference Books

1. Anna Hac, ñWireless Sensor Network Designsò, John Wiley & Sons, 2004.
2. Kazem Sohraby, Daniel Minoli and Taieb Znati, ñWireless Sensor Networks: Technology, Protocols, and Applicationsò, Wiley Inter Science, 2007.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(iii) WAVELETS

Course Requisite:

1. (5ETC03) Digital Signal Processing
2. (7ETC02) Digital Image and Video Processing

Course Objectives: After taking this course student will be capable to:

1. Introduce with basic concepts of Wavelets.
2. Understand the wavelet transform for continuous and discrete time signals
3. Study the basic concepts of multi resolution analysis.
4. Study filter bank algorithm in details.
5. Study the application of wavelet transform for data compression.
6. Learn the application of Wavelet transform in different fields.

Course Outcomes: After successfully completing the course, the students will be able to:

1. Comprehend the fundamentals of wavelets.
2. Explain the concepts, theory, and algorithms related with wavelet transform.
3. Understand the modern signal processing tools using signal spaces, bases, operators etc.
4. Analyse wavelets, filter banks, and multiresolution techniques.
5. Understand data compression techniques using wavelets.
6. Comprehend projects ideas based on wavelet transform.

Unit-I: Introduction to Time Frequency Analysis: Vector Spaces, Properties, Dot Product, Dimension, Orthogonality and Orthonormality, Relationship Between Vectors and Signals, Signal Spaces, Signal representation using basis and frames, Brief introduction to Fourier transform and short time Fourier transform, Time frequency analysis . (6)

Unit-II: Continuous Wavelet transform: Continuous Time Wavelets, definition of CWT, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain (6)

Unit III: Discrete Wavelet Transform and Filter Bank Algorithms: Introduction to Discrete Wavelet Transform, Decimation and Interpolation, Convolution Followed by Decimation, Interpolation Followed by Convolution, Signal Representation in the Approximation Subspace, Wavelet Decomposition Algorithm, Reconstruction Algorithm (6)

Unit-IV: Multi-resolution Analysis: Introduction, Formal definition of MRA, Construction of general orthonormal MRA, A Wavelets basis for MRA, Digital Filtering Interpretations, Examples of orthogonal basis generating wavelets, interpreting orthonormal MRAs for discrete time signal. (6)

Unit-V: Wavelet Transform and Data Compression: Introduction, transform Coding, DTWT for Image Compression, Image compression using DTWT and run length coding, Embedded Tree Image Coding, Audio Compression, Audio Masking, standard specifying sub band implementation, wavelet-based audio coding, video coding using multi-resolution techniques. (6)

Unit-VI: Applications of Wavelet transform: Introduction, Wavelet Denoising, speckle Removal, Edge Detection or Object Isolation, Image Fusion, Object detection by wavelet transform of projections (6)

Text Books:

1. Raghuveer Rao and Ajit S. Bopardikar, Wavelet transforms: Introduction to Theory and applications, Pearson Education Asia, 2000.
2. J. C. Goswami & A. K. Chan, Fundamentals of Wavelets: Theory, Algorithms, and Applications, 2nd edition, Wiley, 2011
3. S. Mallat, A Wavelet Tour of Signal Processing, 2nd edition, Academic Press, 1999.

Reference Books:

1. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston.
2. J. S. Walker, A premier on Wavelets and their scientific applications, CRC press, 2002.
3. Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.
4. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.
5. A.N. Akansu and R.A. Haddad, Multiresolution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.
6. B. Boashash, Time-Frequency signal analysis, In S. Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

8ETC03 PROFESSIONAL ELECTIVE V (PE-V)
(iv) BIO-MEDICAL ELECTRONICS

Course Requisite:
1. (3ETC02) Electronic Devices and Circuits
2. (5ETC01) Microcontroller
3. (7ETC02) Digital Image and Video Processing

Course Objectives:
1. Understanding role of engineers in medical field
2. Studying various electrical signals generated in human body.
3. To study various transducers, electrodes, recorders and problems for recording biomedical signals.
4. Study different medical imaging systems.
5. Introduction to patient care & safety
6. Introduction of various therapeutic life saving instruments.

Course Outcomes:
After successfully completing the course, the students will be able to:
1. Understand fundamentals of Medical Instrumentation, Biomedical Signals and Electrode.
2. Identify and classify various Biomedical Transducers.
3. Illustrate the significance of human signals and recording techniques
4. Familiarize with Modern medical imaging systems.
5. Conceptualize requirements and importance of Patient Care and Monitoring and Safety.
6. Describe the function and necessity of Physiological and electrotherapy equipments.

Unit-I: Introduction: Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Bio potential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory, motion artifacts, Nernst Equation. (6)

Unit-II: Biomedical transducers: Classification of Transducers-Pressure, force, acceleration, flow, respiration sensor, Smart sensors, pulse sensor, temperature, potential, dissolved ions and gases. (6)

Unit-III: Biomedical Recorders and Measurement: Biomedical recorders for EEG, ECG, EMG, Measurement of Blood Pressure: Direct method, Indirect methods- The Rheographic method, Ultrasonic Doppler shift method, Blood flow meter - Square wave electromagnetic, Measurement of Heart rate, Measurement of pulse rate. (6)

Unit-IV: Medical Imaging System: Instrumentation for diagnostics X-rays, X- rays basics properties, X-ray machine, Special imaging techniques: Computerized Axial Tomography (CAT), Ultrasonic imaging system: Physics of Ultrasound, Biological effect of ultrasound. Ultrasonics: A-scan, M-scan, B-scan (6)

Unit-V: Patient Care and Monitoring and Safety:
System concepts, Bedside patient monitors, central monitors, Intensive care monitoring. Biotelemetry: Single channel and Multichannel bio-telemetry, PATIENT SAFETY: Electric shock hazards, leakage current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to minimize electric shock hazards. (6)

Unit-VI: Therapeutic Equipments & Ventilators:
Need of Physiological and electrotherapy equipments. Cardiac pacemakers, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy Machines: Short wave, Microwave, Ultrasonic. Ventilators: Mechanics of respiration, Artificial Ventilators, Microprocessor controlled Ventilators. (6)

Text Books:
1. Khandpur R.S. ñHandbook of Biomedical Instrumentationò, Tata Mc-Graw Hill, New Delhi.
2. Cromwell L. & Wiebell. F. J., ñBiomedical Instrumentationò, PHI Publications.

Reference Books:
1. Webstar J.G., ñMedical Instrumentationò, Third ed. John Wiely & Sons.
2. Carr & Brown, ñIntroduction to Biomedical Equipment Technologyò, Prentice Hall.

8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(i) 5G-6G MOBILE COMMUNICATION

Course Pre-requisites: 7ET04: Mobile Communication and Networks

Course Objectives:
1. To Understand latest trends in wireless technologies, a path towards 5G and 6G system.
2. To study network architecture, components, features and benefits of 5G system.
3. To understand various radio waveforms and channel model for 5G.
4. To understand different networking techniques in 5G system.
5. To study introduction of 6G system.

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

1. Illustrate the evolution of mobile communication leading to the introduction of 5G.
2. Explain the key innovations in radio and network.
3. Elaborate the standardization process and timeline for 5G
4. Identify the spectrum requirements.
5. Discuss key issues and challenges in 5G deployment.
6. Understand the concept of 6G

Unit-I: INTRODUCTION TO 5G:

Historical trend and evolution of LTE technology to beyond 4G ï Key building blocks of 5G ï 5G use cases and System Concepts ï The 5G Architecture ï IoT: relation to 5G. (6)

Unit-II: RF FRONT END FOR 5G:

Millimeter Wave Communications: Hardware technologies for mmW systems ï Architecture and Mobility ï Massive MIMO: Resource allocation and Fundamentals of baseband and RF implementations in massive MIMO ï Beam forming. (6)

Unit-III: 5G WAVEFORMS AND CHANNEL MODELS:

5G Radio Access Technologies: Radio Access for V2X Communication - Radio access for massive machine-type communication - 5G wireless propagation channel models: Modelling requirements and scenarios. (6)

Unit-IV: NETWORKING IN 5G:

Coordinated multi-point transmission in 5G: Joint Transmission CoMP enablers - Distributed cooperative transmission - Relaying and network coding in 5G: Multi-flow wireless backhauling - Buffer aided relaying. (6)

Unit-VI: APPLICATIONS of 5G:

Machine-type communications: Fundamental techniques for MTC - Massive MTC - Ultra-reliable low-latency MTC - Device-to-device (D2D) communications - Multi-hop D2D communications - Multi-operator D2D communication - Simulation methodology: Evaluation methodology ï Calibration (6)

Unit-VI: INTRODUCTION TO 6G:

Key building blocks of 6G ï 6G use cases and System Concepts ï The 6G Architecture. (6)

Text Books:

1. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017.
2. Afif Osseiran, Jose F. Monserrat and Patrick Marsch, - 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.

Reference Book: Jonathan Rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.

8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(ii) INFORMATION THEORY AND CODING

Course Prerequisite:

1. 3ETC03: Digital System Design
2. 4ETC01: Analog and Digital Communication

Course Objectives: Students undergoing this course are expected to:

1. Understand the basics of information theory and coding theories.
2. Introduce the concept of amount of information, entropy, channel capacity, error-detection and error-correction codes, block coding, convolution coding.
3. Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
4. Describe the real life applications based on the fundamental theory.
5. Calculate entropy, channel capacity, bit error rate, code rate, and steady-state probability and so on.
6. To get exposed to information and entropy, compression technique, audio & video

Course Outcomes: After successfully completing the course, the students will be able to:

1. Understand the concept of information and entropy
2. Understand Shannonôs theorem for coding
3. Calculation of channel capacity
4. Discuss the various capacity reduction based coding techniques for text, audio and speech type of data
5. Compare various capacity reduction based coding techniques for image and video type of data.
6. Implement various error control techniques for Convolutional codes

Unit-I: Basics of information theory, Entropy, Information rate, classification of codes, entropy for discrete ensembles; Source coding theorem, Shannon-Fano coding, Huffman coding. (6)

Unit-II: Extended Huffman coding ï Joint and conditional entropies, Mutual information ï Discrete memoryless channels ï BSC, BEC ï Channel capacity, Shannon limit Shannon's noiseless Coding theorem; Encoding of discrete sources. (6)

Unit-III: Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels. **(6)**

Unit-IV: Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 ï Speech: Channel Vocoder, Linear Predictive Coding. (7)

Unit-V: Image and Video Formats ï GIF, TIFF, SIF, CIF, QCIF ï Image compression: READ, JPEG Video Compression: Principles-I, B, P frames, Motion estimation, Motion compensation, MPEG standard. (6)

Unit-VI: Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes. **(**5)

Text Books :

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

Reference Books :

1. R.B. Ash, Information Theory, Prentice Hall, 1970.
2. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Publication,2005

8ETC04 PROFESSIONAL ELECTIVE VI (PE-VI)
(iii) SCIENTIFIC COMPUTING

Course Prerequisite: 3ETC01: Engineering Mathematics-III

Course Objectives: To enable the student to understand :

1. the basics of scientific computing
2. variety of tools and techniques to transform into computer model
3. Use of Matlab and python in scientific computing.

Course Outcomes: After successfully completing the course, the students will be able to:

1. View scientific computing as the point of intersection between computer science, numerical mathematics, and modeling.
2. introduce to numerical mathematics and prepares them for the scientific computing part.
3. Learn to solve Nonlinear equations useful for computer models
4. Learn to solve Numerical differentiation useful for computer models
5. Learn to use MATLAB
6. Learn to use python for the applications in scientific computing

Unit-I: Introduction to scientific computing, applications involving scientific computing, Tools and languages to solve complex scientific problems. (6)

Unit-II: Systems of Linear Algebraic equations: Introduction, Gauss Elimination Method, LU decomposition, Symmetric and banned coefficient Matrices, Pivoting, Matrix Inversion, Iterative Methods, Other methods. (6)

Unit-III: Solving Nonlinear Equations. The Bisection Method for Root-Finding.,Convergence Criteria and Efficiency, Scripts and Function Files , The False Position Method, The Newtonð Raphson Method for Root-Finding , Fixed Point Iteration. (6)

Unit-IV: Numerical Differentiation: Finite Difference approximations; Numerical Integration; Initial Value Problems; Two-Point Boundary Value Problems; Symmetric Matrix Eigen value problems; Introduction to Optimization. (6)

Unit-V: Basics of MATLAB. Defining and Using Scalar Variables, Saving and Reloading the Workspace, Defining and Using Arrays, Operations on Vectors and Matrices, more on Plotting Functions of One Variable, Loops and Logical Operators, Working with indices and arrays, Number representation. (6)

Unit VI:: Scientific computation using python - Statistical data analysis, image processing, web development and hardware interfacing using Python. (6)

Text Books:

1. Hans Petter Langtangen, A Primer on Scientific Programming with Python (Link)
2. Claus Fuhrer, Jan Erik Solem, Olivier Verdier, Scientific Computing with Python 3 Packt Publishing Limited
3. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education
4. Hemant Kumar Mehta, Mastering Python Scientific Computing, Packt Publishing Limited

Reference Books:

1. By Dan Stanescu Long Lee ,òA Gentle Introduction to Scientific Computing ñ, First edition Chapman and Hall/CRC
2. Jaan Kiusalaas, ñNumerical Methods in Engineering with Pythonò, Cambridge University Press, 2005.

8ETC05- EMBEDDED SYSTEMS LAB

1. Minimum Eight Experiments based on syllabus of 8ETC01: Embedded Systems must be conducted.
2. Course Objectives and Course Outcomes shall be specified based on the experiments conducted

8ETC06- CRYPTOGRAPHY AND NETWORK SECURITY LAB

1. Minimum Eight Experiments based on syllabus of 8ETC02: Cryptography and Network Security must be conducted.
2. Course Objectives and Course Outcomes shall be specified based on the experiments conducted.

8ETC07- PROJECT STAGE-II

Course Objectives: Students will be required to:

1. Perform a literature search to review current knowledge and developments in the chosen technical area;
2. Undertake detailed technical work in the chosen area using one or more of:
   - theoretical studies
   - computer simulations
   - hardware construction;
3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project;
4. Deliver a seminar on the general area of work being undertaken and specific contributions to that field;
5. Prepare a formal report describing the work undertaken and results obtained so far; and
6. Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.

Course Outcomes: On successful completion of the course students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilising a systems approach.
4. Conduct an engineering project.
5. Communicate with engineers and the community at large in written an oral forms.
6. Demonstrate the knowledge, skills and attitudes of a professional engineer.

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