ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME AND SYLLABI : (With effect from 2022-23 admitted batch)

B.Tech & B.Tech + M.Tech

I Year - I Semester

Course code	Category	Course Title	Hours per week L	T	Internal Marks	External Marks	Total Marks	Credits
EC1101	BS	Mathematics – I	4	0	30	70	100	3
EC1102	BS	Physics	4	0	30	70	100	3
EC1103	ES	Digital Logic Design	4	0	30	70	100	3
EC1104	ES	Electronic Devices and Circuits	4	0	30	70	100	3
EC1105	ES	Network Theory and Machines	4	0	30	70	100	3
EC1106	ES	Digital Logic Design Lab	0	3	50	50	100	1.5
EC1107	BS	Physics Lab	0	3	50	50	100	1.5
EC1108	ES	Electronic Devices and Circuits Lab	0	3	50	50	100	1.5
		Total Credits						19.5

I Year - II Semester

EC1201	BS	Mathematics – II	4	0	30	70	100	3
EC1202	BS	Green Chemistry	4	0	30	70	100	3
EC1203	HSS	English	4	0	30	70	100	3
EC1204	ES	Computer Programming and Numerical Methods	4	0	30	70	100	3
EC1205	ES	Electronic Circuit Analysis	4	0	30	70	100	3
EC1206	HSS	English Language Lab	0	3	50	50	100	1.5
EC1207	BS/ES	Electronic Circuit Analysis Lab	0	3	50	50	100	1.5
EC1208	ES	Computer Programming and Numerical Methods Lab	0	3	50	50	100	1.5
		Total Credits						19.5

II Year - I Semester

EC2101	BS	Mathematics -III	4	0	30	70	100	3
EC2102	PC	Python Programming	4	0	30	70	100	3
EC2103	PC	Analog Communications	4	0	30	70	100	3
EC2104	PC	Signals & Systems	4	0	30	70	100	3
EC2105	HSS	Managerial Economics	4	0	30	70	100	3
EC2106	PC	Python Programming Lab	0	3	50	50	100	1.5
EC2107	PC	Analog Communications Lab	0	3	50	50	100	1.5
EC2108	PC	Signals & Systems Simulation Lab	0	3	50	50	100	1.5
EC2109	SC	Digital Circuits Simulation	1	2	50	50	100	2
EC2110	MC	Professional Ethics and Universal Human Values	0	0	00	100	100	0
EC2111	MC	NCC/NSS	0	2	-	-	-	0
		Total Credits						21.5

II Year - II Semester

EC2201	ES	Probability theory and Random Process	4	0	30	70	100	3
EC2202	PC	Electromagnetic Field Theory and Transmission Lines	4	0	30	70	100	3
EC2203	PC	Microprocessors and Microcontrollers	4	0	30	70	100	3
EC2204	PC	Linear ICs & Applications	4	0	30	70	100	3
EC2205	PC	Pulse and Digital Circuits	4	0	30	70	100	3
EC2206	PC	Microprocessors & Microcontrollers Lab	0	3	50	50	100	1.5
EC2207	PC	Linear ICs & Pulse Circuits Lab	0	3	50	50	100	1.5
EC2208	SC	Electronic Circuits Simulation	1	2	50	50	100	2
EC2209	MC	Environmental Science	0	0	00	100	100	0
		Total Credits						20

Internship-I

EC1101 : MATHEMATICS - I

Course Objectives:

The objectives of this course are

* To transmit the knowledge of Partial differentiation.

* To know of getting maxima and minima of function of two variables and finding errors and approximations.

* To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

Course Outcomes:

At the completion of the course the student will be able to

* Find the partial derivatives of functions of two or more variables.

* Evaluate maxima and minima, errors and approximations.

* Evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

* Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

SYLLABUS

Partial Differentiation: Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs)

Applications of Partial Differentiation: Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

Multiple Integrals: Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Multiple Integrals-Applications: Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

Fourier series: Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

Text Books:

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

EC1102 : PHYSICS

Course Objectives:

The objectives of this course are

* To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.

* To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonic's and their applications in engineering.

* To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.

* To learn basics of lasers and optical fibers and their use in some applications.

* To understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

Course Outcomes:

At the completion of the course the student will be able to

* Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.

* Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications.

* Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit.

* Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.

* Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one-Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

SYLLABUS

Thermodynamics: Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

Electromagnetism: Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonic's: Introduction, Production of Ultrasonic's – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonic. **Optics: Interference:** Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications. **Diffraction**: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment). **Polarization:** Polarization by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

LASERS and FIBER OPTICS: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers. Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fiber, Numerical aperture, Modes of propagations, classification of fibers, Fiber optics in communications, Application of optical fibers.

Modern Physics: Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semiconductors and insulators.

Nanophase Materials : Introduction, properties, Top-down and bottom-up approaches, Synthesis - Ball milling, Chemical vapor deposition method, sol-gel methods, Applications of Nano materials.

Text Books:

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.

2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

Reference Books:

1. Modern Engineering Physics by A.S. Vadudeva

2. University Physics by Young and Freedman

EC1103 : DIGITAL LOGIC DESIGN

Course Objectives:

The objectives of this course are

* To understand Different number systems, digital logic, simplification and minimization of Boolean functions.

* To analyze logic processes and implement logical operations using combinational logic circuits.

* To analyze the characteristics of memory and their classification.

* To design combinational & sequential digital circuits and state machines.

* To understand about programmable logic devices.

Course Outcomes:

At the completion of the course the student will be able to

* Discuss the significance of number systems, conversions, binary codes.

* Apply different simplification methods for minimizing Boolean functions.

* Analyze the design concepts of various combinational circuits.

* Analyze the concepts of sequential logic design.

* Categorize Mealy & Moore models and Design Synchronous Sequential machines.

SYLLABUS

Number systems and codes: Number systems, Base conversion methods, Complement of numbers, Codes: Binary, Non binary, Decimal, Alphanumeric, Gray, and Error detecting and error correcting codes. Logic Gates: AND, OR, NOT, NAND, NOR, XOR, EX-NOR and Universal Gates

Minimization of Boolean Functions: Fundamental postulates of Boolean algebra, Basic theorems, Simplification of Boolean equations, Min terms, Max terms, Standard form of Boolean functions. Simplification of functions: Karnaugh map method and Quine-McClusky methods (up to six variables), Multiple Output functions, and incomplete specified functions.

Combinational Logic-Circuit Design-1: Logic design of combinational circuits: Adders and Subtractions: Binary, BCD, Excess -3 and Look –ahead-carry adder, Code converters, Multiplexers, De multiplexers, Encoders, Decoders and priority encoders, Realization of Boolean functions using multiplexers, De multiplexers and Decoders.

Combinational Logic-Circuit Design-I1: Design of 4-bit comparator, Parity checker/Generator, Seven segment decoders, Hazards in combinational circuits, Hazard free realizations. Basics of PLDs: Basic structure of PROM, PAL, PLA, CPLD, FPGAs, Realization of Boolean functions with PLDs and their merits and demerits.

Sequential circuits: Classification of sequential circuits, SR-latch, Gated latches, Flip flops: RS, JK, D, T and Master slave flip flops, Excitation tables, flip flop conversion from one type to another. Design of counters: Ripple counters, Synchronous counters, asynchronous counters, up-down counters, Johnson counter, ring counter. Design of registers: Buffer registers, Shift registers, Bi directional shift registers, Universal shift register.

Analysis and design of finite state machines: State assignment, State tables, Equivalent states, Elimination of Redundant states, Determination of state equivalence, Reduction using implication table, and reducing incompletely specified state tables.

Text Books:

1. Switching and finite Automatic theory, ZuiKohari, TMH
2. Switching theory and logic design by Frederick.J.Hill and Gerald.R.Peterson
3. Switching theory and logic design, Ananda kumar, PHI.

Reference Books:

1. Fundamentals of Logic Design, Charles.R.Roth, Thomson Publications.
2. Digital Design by Morries Mono, PHI.

EC1104 : ELECTRONIC DEVICES AND CIRCUITS

Course Objectives:

The objectives of this course are

* To understand the operation of semiconductor devices.
* To understand DC analysis and AC models of semiconductor devices.
* To apply concepts for the design of Filters, Regulators, Oscillators and Amplifiers for different applications.
* To Analyze the theoretical concepts through laboratory and simulation experiments.
* To apply how to implement mini projects using electronic circuit concepts.

Course Outcomes:

At the completion of the course the student will be able to

* Illustrate fundamentals of semiconductor physics for active devices.
* Demonstrate the characteristics of PN Junction diodes and Zener Diode.
* Illustrate the functional behavior of rectifiers and filters.
* Examine the V-I characteristics in different types of transistors.
* Analyze the V-I Characteristics and applications of Special Devices.
* Analyze the frequency response of the BJT amplifiers

SYLLABUS

Energy band theory of solids and transport phenomenon in semiconductors: Energy Band Theory of Solids Intrinsic and Extrinsic Semiconductors Doping, Doping Materials, Carrier Mobility, Conductivity, Diffusion and continuity equation, Hall – Effect. Semiconductor Diodes Band structure of PN Junction, Quantitative Theory of PN Diode, and Volt – Amp. Characteristics, Temperature Dependence, Transition and Diffusion Capacitance of PN Junction.

Rectifiers and special diodes: Diode Rectifiers: Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Ripple Factor and Regulation Characteristics. Zener and Avalanche Breakdowns, Tunnel Diode, LED, Schottky Barrier Diode, Varactor Diode, Photo Diode, PIN Diode.

Transistor Characteristics and Transistor Biasing: Bipolar Junction Transistor NPN and PNP junction Transistor, Characteristics of Current Flow across the Base Regions, Minority and Majority Carrier Profiles, CB, CE and CC Configurations and their Input and Output Characteristics. Comparison of CE, CB, and CC Configurations. Junction Biasing for Saturation, Cutoff and Active Region, á and â Parameters and the relation between them, Biasing circuits, thermal runaway, thermal stability, stabilizations circuits.

Transistor at Low Frequencies: Small Signal: Low Frequency Transistor Amplifier Circuits Transistor as an Amplifier, h – parameter model, Analysis of Transistor Amplifier Circuits using h –parameters. CB, CE and CC Amplifier configurations and performance factors. Analysis of Single Stage Amplifier, RC Coupled Amplifiers. Effects of Bypass and Coupling Capacitors. Frequency Response of CE Amplifier, Emitter – Follower, Cascaded Amplifier.

Field Effect Transistors: JFET and its characteristics, Pinch off Voltage, Drain Saturation Current, , MOSFET –Enhancement and Depletion Modes, JFET Configurations, JFET biasing, Small signal models of FET, JFET Common Source amplifier.

Text Books:

1. Integrated Electronics, Analog Digital Circuits and systems, Jacob Millman and D. Halkias, McGraw Hill.
2. Electronic Devices and Circuits, G.S.N. Raju, I.K. International Publications, New Delhi, 2006.

Reference Books:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
2. Electronic Devices and Circuits 2nd Edition, B. V. Rao and K. Raja Rajeswari, Pearson Education.
3. Electronic Devices and Circuits, K. Venkat Rao, K. Rama Sudha, McGraw Hill education, Edition-2015.
4. Electronic Devices and Circuits Theory, Boylsted and Nashelsky, Prentice Hall Publications.

EC1105 : NETWORK THEORY AND MACHINES

Course objectives:

The objectives of this course are

* will be able to articulate in working of various components of a circuit.

* will be familiar with application of theorems to ac and dc circuits

* ability to Express given Electrical Circuit parameter and Solve the circuits.

* understand the operating principle of DC motor and DC generator

* will know about construction features of dc and ac machines

* able to find the performance of a dc and ac machines for a given specifications

Course Outcome:

Upon completion of the course the student should have the ability to

* analyze the Fundamentals of D.C circuits.

* apply the concept of Node and Mesh analysis.

* analyze the Network theorems.

* analyze and determine Fundamentals of A.C circuits.

* apply and analyze the working of DC machines.

* apply and analyze the working of AC machines.

Analysis of DC Circuits

Active elements, Passive elements, Reference directions for current and voltage, Kirchoffs Laws, Voltage and Current Division, Nodal Analysis, Mesh analysis, Linearity and superposition, Thevinin's theorem and Norton's theorem, star-delta transformations, Source Transformation, Maximum power transfer theorem, Reciprocity theorem, Z,Y,H,S parameters.

DC transients

Inductor, Capacitor, source free RL, RC and RLC response, Evaluation of Initial conditions, Application of unit-step function to RL, RC and RLC circuits, concepts of Natural, Forced and Complete response.

Introduction to AC circuits

The sinusoidal forcing function instantaneous, Phasor concept, Average and Effective value of Voltage and Current, instantaneous and Average Power, Complex Power steady state analysis using mesh and node analysis, application of network theorems to AC circuits, resonance, Concept of Duality.

DC Machines

Principle of operation of DC machines, Constructional Details, EMF equation, Types of DC machines, Torque Equation, Characteristics of DC Generators, necessity of starters, speed control methods, DC Motor Characteristics, applications of DC Machines, Swinburne's Test, Brake test on DC shunt motor.

AC Machines

Transformer Principle of operation and construction Details, EMF equation, Open Circuit & Short Circuit Test, Principle of operation of Three Phase Induction Motors, Constructional Details, Principle of operation of Single Phase Motor, Double Revolving Field Theory, Universal Motor, Stepper Motor, Principle of operation of synchronous machines, Synchronous Condenser and Applications.

Text Books:

1. Electrical Circuits by A.Chakrabarthy- Dhanapat Raj and Sons.

2. Engineering Circuit analysis By William Hayt and JackE,kemmerly-TMH.

3. A Textbook of Electrical Technology : Ac and Dc Machines (volume - 2) by B L Theraja and A K Theraja.

4. A First Course In Electrical Engineering, S. M. Tiwari, A. S. Binsaroor, Wheeler Publications.

Reference Books:

1. Principles Of Electrical Engineering And Electronics by V.k. Mehta and Rohit Mehta, S.Chand.

2. Electrical Machines, S. K. Bhattacharya, TMH Publications N. Delhi.

EC1106 : DIGITAL LOGIC DESIGN LAB

Course Objectives:

The objectives of this course are

* To Verify Logic gates

* To Verify Half adders and full adders

* To Design ripple counter and synchronous counter

* To Design shift registers and seven segment display.

Course Outcomes:

At the end of the course the student will be able to

* Implement logic gates and their realization using ICs

* Implement and analyze combinational and sequential circuits using ICs

* Implement the logic gates, full Adder, Decoder, Encoder, MUX and DeMUX.

* Implement and Analyze Flip-Flops, Shift Register and Counters.

SYLLABUS

List of Hardware Experiments:

1. Logic Gates

2. Realization of Gates by using universal building blocks

3. Realization of SOP and POS

4. Verification of Demorgan's Laws

5. Half Adder & Full adder

6. Function generation by using Decoders & Multiplexers.

7. Realization of Flip - flops

8. 4-bit Ripple counter

9. Mod-8 Synchronous counter

10. Up down counter

11. 4 - bit Shift-register

12. Seven segment display

EC1107 : PHYSICS LAB

Course Objectives:

The objectives of this course are

* To enable the students to acquire skill, technique and utilization of the Instruments

* To draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.

* To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.

* To familiarize the handling of basic physical apparatus like Venire calipers, screw gauge, spectrometers, travelling microscope, laser device, optical fiber, etc.

Course Outcomes:

At the completion of the course the student will be able to

* Ability to design and conduct experiments as well as to analyze and interpret.

* Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics**.**

* The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

* Determine the Thickness for given paper strip by wedge method

SYLLABUS

List of Experiments:

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.

2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.

3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.

4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.

5. Determination of Refractive Index of Ordinary ray m_o and extraordinary m_e ray.

6. Determination of Thickness Given Paper Strip by Wedge Method.

7. Calibration of Low Range Voltmeter.

8. Calibration of Low Range Ammeter.

9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.

10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.

11. Carey Foster's Bridge – Verification of laws of Resistance and Determination of Specific Resistance.

12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.

13. Photoelectric cell-Characteristics.

14. Planks Constants.

15. Laser- Diffraction.

EC1108 : ELECTRONIC DEVICES AND CIRCUITS LAB

Course Objectives:

The objectives of this course are

* To Study semiconductor diodes; verify their characteristics and applications of diodes as regulators, rectifiers.

* To Measure the V-I characteristics of various devices that are used in the electronic equipment.

* To Verify functionality through V-I characteristics of active devices like BJT, JFET, MOSFETS and their applications.

* To Determine the gain of CE amplifier

Course Outcomes:

At the completion of the course the student will be able to

* Comprehend the depth of semiconductor devices like diodes, transistor, JFET, MOSFETs characteristics.

* Measure voltage, frequency and phase of any waveform using CRO.

* Generate sine, square and triangular waveforms with required frequency and amplitude using function generator.

* Gain hands on experience in handling electronic components and devices.

* Study and verify various amplifier designs with calculation of impedance and band width.

SYLLABUS

List of Experiments:

1. Study of CRO and Applications.
2. V-I Characteristics of PN Junction Diode
3. V-I Characteristics of Zener Diode and Zener regulator characteristics.
4. V-I Characteristics of LED
5. V-I characteristics of Photo diode
6. Half-wave and full-wave rectifiers
7. Half-wave and full-wave rectifiers with capacitor filter
8. CE characteristics of BJT, h-parameters
9. CB characteristics of BJT, h-parameters
10. Voltage gain, input impedance and output impedance of emitter follower
11. Drain and transfer characteristics of JFET
12. Frequency response of CE amplifier

EC1201 : MATHEMATICS – II

Course Objectives:

The objectives of this course are

* The way of obtaining rank, Eigen values and Eigen vectors of a matrix.

* To know the importance of Clayey-Hamilton theorem and getting canonical form from a given quadratic form.

* To solve the system of equations by using direct and indirect methods.

* To solve first order and higher order differential equations by various methods.

* To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes:

At the completion of the course the student will be able to

* Find rank, Eigen values and Eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.

* Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.

* Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling.

* Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

* Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications: Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

Laplace Transforms: Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Books:

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

EC1202 : GREEN CHEMISTRY

Course Objectives:

* To apply the basic knowledge of Chemistry to the Engineering Discipline.

* To develop knowledge about water and its treatment for industrial and potable purposes.

* To develop understanding in the areas of Batteries, Fuels Mechanism of Corrosion of Metals and Corrosion Control Methods, Green Chemistry andTechnology and Processes involving Green Chemistry and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course outcomes:

* The students are able to apply the basic concepts and principles studied in Chemistry to the field of Engineering.

* The students are able to apply chemistry to different branches of engineering

* The students are able to acquire the knowledge in the areas of Water Chemistry, Mechanism of Corrosion of Metals and Corrosion Control Methods, Batteries, Fuel Cells, Green Chemistry and Technology and Processes involving Green Chemistry and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Unit 1: Water Technology : Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Unit 2: Batteries : Primary batteries: The chemistry - Types: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium-ferrous sulphide cells. Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery – sodium-beta and redox batteries.

Unit 3: Fuel Cells : Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspectsof the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells- Membranes and Fuels

Unit 4: Corrosion : Corrosion**:** Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion. Corrosion Controlling Methods: Protective Coatings: Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Unit 5: Green Chemistry and Technology : Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 6: Processes involving Green Chemistry : Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

Text Books :

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.

2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.

3. Dell, Ronald M Rand, David A J, ‘Understanding Batteries’, Royal Society of Chemistry, (2001).

4. M. Aulice Scibioh and B. Viswanathan ‘Fuel Cells – principles and applications’, University Press, India (2006).

5. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

6. Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 1998.

EC1203 : ENGLISH

Course Objectives:

The objectives of this course are

* To make students understand the explicit and implicit meanings of a text/topic;

* To give exposure to new words and phrases, and aid to use them in different contexts.

* To apply relevant writing formats to draft essays, letters, emails and presentations.

* To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes:

At the completion of the course the student will be able to

* Analyze a given text and discover the various aspects related to language and literature;

* Learn the various language structures, parts of speech and figures of speech;

* Develop one's reading and writing abilities for enhanced communication

* To apply the topics in real-life situations for creative and critical use.

SYLLABUS

On the conduct of life: William Hazlitt

Life skills: Values and Ethics

If: Rudyard Kipling

The Brook: Alfred Tennyson

Life skills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki

Life skills: Time Management

On saving Time: Seneca

Chindu Yellama

Life skills: Innovation

Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar: Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary: Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing: Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

Writing: Essay Writing

Life skills: Innovation

Muhammad Yunus

Text Books:

Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

Reference Books:

1. Practical English Usage, Michael Swan. OUP. 1995.
2. Remedial English Grammar, F.T. Wood. Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

EC1204 : COMPUTER PROGRAMMING AND NUMERICAL METHODS

Course Objectives:

The objectives of this course are

* To provide complete knowledge of C language.

* To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

* To provide knowledge to the Students to develop logics this will help them to create programs, applications in C.

* This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

* This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

At the completion of the course the student will be able to

* Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and apply them in problem solving.

* Apply various operations on derived data types like arrays and strings in problem solving.

* Design and implement of modular Programming and memory management using Functions, pointers.

* Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.

* Apply Numerical methods to solve the complex Engineering problems.

SYLLABUS

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications.

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

File handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Books:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.

2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C, Yashwant Kanetkar, BPB Publications, 5th Edition.

2. Computer Science, A structured programming approach using C", B.A. Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.

3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.

4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

EC1205 : ELECTRONIC CIRCUIT ANALYSIS

Course Objectives:

The objectives of this course are

* To prepare students to perform the analysis of any Analog electronics circuit.

* To empower students to understand the design and working of BJT / FET.

* To empower students to understand the design and working of amplifiers and oscillators.

* To empower students to understand the design and working of Operational Amplifier.

* To prepare the students for advanced courses in Communication system Circuit Design.

Course Outcomes:

At the end of the course the student will be able to

* Acquire basic knowledge of physical and electrical conducting properties of semiconductors.

* Develop the Ability to understand the design and working of BJT / FET amplifiers and Operational Amplifier.

* Develop the Ability to understand the design and working of BJT / FET oscillators.

* Develop the Ability to understand the design and working of Communication system Circuit Design.

SYLLABUS

Small Signal High Frequency Transistor Amplifier models: BJT: Transistor at high frequencies, Hybrid- common emitter transistor model, Hybrid-conductance's, Hybrid- capacitances, validity of Hybrid- model, determination of high frequency parameters in terms of low frequency parameters, CE short circuit current gain, current gain with resistive load, cut-off frequencies, frequency response and gain bandwidth product. **FET:** Analysis of common source and common drain amplifier circuits at high frequencies.

Multistage Amplifiers: BJT and FET RC Coupled Amplifiers – Frequency Response. Cascaded Amplifiers. Calculation of Band Width of Single and Multistage Amplifiers. Concept of Gain Bandwidth Product.

Feedback Amplifiers: Concept of Feedback Amplifiers – Effect of Negative feedback on the amplifier Characteristics. Four Feedback Amplifier Topologies. Method of Analysis of Voltage Series, Current Series, Voltage Shunt and Current Shunt feedback Amplifiers.

Sinusoidal Oscillators: Condition for oscillations –LC Oscillators – Hartley, Colpitts, Clapp and Tuned Collector Oscillators, Frequency and amplitude Stability of Oscillators – Crystal Oscillators – RC Oscillators — RC Phase Shift and Wein bridge Oscillators (BJT and JFET models)

Tuned Voltage Amplifiers and Power Amplifiers: Single Tuned and Stagger Tuned Amplifiers – Analysis, Double Tuned Amplifier, Bandwidth Calculation. Classification of Power Amplifiers – Class A, Class B and Class AB power Amplifiers. Series Fed, Single Ended Transformer Coupled and Push Pull Class A and Class B Power Amplifiers. Cross-over Distortion in Pure Class B Power Amplifier, Class AB Power Amplifier – Complementary Push Pull Amplifier, Derating Factor – Heat Sinks.

Text Books:

1. Integrated Electronics, Analog Digital Circuits and systems, Jacob Millman and D. Halkias, McGraw Hill, 1972.

2. Electronic Devices , G.S.N. Raju, IK International Publications, New Delhi, 2006.

3. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.

Reference Books:

1. Electronic Circuit Analysis, B.V.Rao, K. RajaRajeswari et.al, Pearson Publishers.

2. Electronic Devices and Circuits by Salivahanan, N.Suresh Kumar andA.Vallava Raj TMH, 2nd Edition, 1998

3. Electronic Devices and Circuits – G.K.Mithal, Khanna Publishers, 23rd Edition, 2004.

EC1206 : ENGLISH LANGUAGE LAB

Course Objectives:

The objectives of this course are

* To make students recognize the sounds of English through Audio-Visual aids;

* To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;

* To familiarize the students with stress and intonation and enable them to speak English effectively;

* To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:

At the completion of the course the student will be able to

* Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;

* A study of the communicative items in the laboratory will help students become successful in the competitive world;

* Students will be able to participate in group activities like roleplays, group discussions and debates; and

* Students will be able to express themselves fluently and accurately in social as well professional context.

SYLLABUS

1. **Introduction to Phonetics:** The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

2. **Listening Skills:** Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

3. **Speaking Skills**: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

4. **Reading and Writing skills:** Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

5. **Presentation skills**: Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books:

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.

2. Speak Well. Orient Blackswan Publishers, Hyderabad.

3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

EC1207 : ELECTRONIC CIRCUIT ANALYSIS LAB

Course Objectives:

The objectives of this course are

* To Design feedback amplifiers

* To generate a sinusoidal signal using oscillators

* To simulate oscillators and power amplifiers

* To determine the frequency response of op-amp

Course Outcomes:

At the end of the course the student will be able to

* Design oscillators to generate sinusoidal signal of desired frequency

* Determine the frequency response of BJT and JFETs amplifiers.

* Design the applications of op-amp and determine the frequency response of op-amp

* Simulate BJT, JFET amplifiers using Multisim

* Simulate power amplifiers using Multisim

SYLLABUS

List of Experiments:

1. Current series feedback Amplifier
2. Voltage Shunt feedback amplifier
3. Voltage series feedback Amplifier
4. Colpitts oscillator
5. RC-Phase shift oscillator
6. Wein bridge oscillator
7. Hartley Oscillator
8. JFET Common source Amplifier
9. Two stage RC-Coupled Amplifier
10. JFET two stage amplifier
11. Class A power amplifier.
12. Class-B Push pull Amplifier

EC1208 : COMPUTER PROGRAMMING AND NUMERICAL METHODS LAB

Course Objectives:

The objectives of this course are

* To impart writing skill of C programming to the students and solving problems.

* To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

* To write and execute programs in C to solve problems such as arrays, files, strings structures and different numerical methods.

* This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes:

At the completion of the course the student will be able to

* Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.

* Analyzing the complexity of problems, modularize the problems into small modules and then convert them into programs.

* Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.

* Apply and practice logical ability to solve the real world problems.

* Apply Numerical methods to solve the complex Engineering problems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?

2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).

3. Write a set of string manipulation functions e.g. for getting a sub-

string from a given position, Copying one string to another, Reversing a string, adding one string to another.

4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.

6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).

7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.

8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.

9. Implement bisection method to find the square root of a given number to a given accuracy.

10. Implement Newton Raphson method to det. a root of polynomial equation.

11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/

12. Write a function which will invert a matrix.

13. Implement Simpson's rule for numerical integration.

14. Write a program to solve a set of linear algebraic equations.

EC2101 : Mathematics – III

Course Objectives:

The student should be able to learn the concepts:

* About the differential operators like gradient, divergence and curl.

* Evaluation of Line integrals, Surface integrals, Volume integrals and their transformations using Green's theorem, Stoke's theorem, Gauss Divergence theorems along with their applications in Engineering..

* Differentiation and integration of complex functions and evaluation of complex integration using Cauchy's theorem and Cauchy's integral formula.

* Conformal mappings, expansion of complex functions as Taylor's and Laurent's series. Evaluation of integrals using Cauchy's Residue Theorem.

* Formulate the Partial Differential Equations. Solving first order linear and non-linear Partial Differential Equations, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients. The concept of Fourier Transforms, Fourier Sine, Cosine and their applications to Engineering problems.

Course outcomes:

On completion of this course, students are able to

* Interpret the meaning and evaluation of different differential operators such as gradient, curl and divergence.

* Apply Line integrals, Surface integrals, Volume integrals and their relations using Green's theorem, Stoke's theorem, Gauss Divergence theorems in various engineering applications .

* Apply Cauchy-Riemann equations to complex functions to verify analyticity. Evaluation of integration along the given path using Cauchy's theorem and Cauchy's integral formula.

* Represent a given complex function in Taylor's & Laurent's series in the given region. Make use of the Cauchy residue theorem to evaluate certain integrals.

* Formation, solution of first order linear, non-linear Partial Differential Equations, solution of higher order linear Partial Differential Equations The use of the knowledge of Fourier transforms, Fourier Sine, Cosine as a mathematical tool to evaluated certain wave forms.

SYLLABUS

Unit-I : (VECTOR CALCULUS-DIFFERENTIATION) : Differentiation of vectors, curves in space, velocity and acceleration, scalar and vector point functions, vector operator Ñ applied to scalar point functions- gradient, Ñ applied to vector point functions- divergence and curl. Physical interpretation of gradient, divergence and curl (i.e., ∇f, $\nabla.\overline{F}$, $\nabla \times \overline{F}$), Irrotational and Solenoidal fields, the relations obtained after Ñ applied twice to point functions, Ñ applied to products of two functions.

Unit-II : (VECTOR INTEGRATION) : Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stoke's theorem, volume integral, Gauss Divergence theorem. (All theorems without proofs)

Unit-III : (Functions of Complex Variables) : Introduction-Limit and continuity of f(z)- Derivative of f(z), Cauchy-Reimann Equations, Analytic Functions, Harmonic functions, Applications to flow problems. Integration of complex functions, Cauchy's theorem, Cauchy's integral formula and their applications.

Unit-IV : (Conformal Mappings and Contour Integration) : Introduction to

Conformal transformation, Bilinear transformation $w = \frac{az+b}{cz+d}$, Series of complex terms -Taylor's and Laurent's series (without proofs), Zero's and Singularities. Residues and Calculations of residues, Cauchy's Residue Theorem (without proofs).

Unit-V : PARTIAL DIFFERENTIAL EQUATIONS & FOURIER TRANSFORM : Introduction and formation of partial differential equations, solutions of partial differential equations, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order. Homogeneous linear equations with constant coefficients- complementary function, particular integral, non- homogeneous linear equations.

Introduction, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, properties of Fourier transforms. Convolution theorem, Parseval's identity for Fourier transforms.

TEXT BOOKS:

Scope and treatment as in "Higher Engineering Mathematics", by Dr. B.S.Grewal, 43rd Edition, Khanna Publishers.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics by Erwin Kreyszig.
2. A Text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
3. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.
4. Complex variables and applications, James Ward Brown, Ruel V. Churchill, McGraw Hill.

EC2102 : PYTHON PROGRAMMING

Course Objectives :

* To develop skills on procedural oriented and object oriented programming in Python.

* To understand and apply different data wrangling techniques using Python.

* To perform data analysis using python libraries like NumPy, Pandas and exploratory data analysis using Matplotlib

Course Outcomes :

At the end of the course, a student should be able to:

* acquire programming knowledge on Basics of Python

* acquire programming knowledge on Text and File Handling

* develop Python programs to Mean, Median, Mode, Correlation

* acquire programming knowledge on NumPy, Pandas Library

* acquire programming knowledge on Graph Visualizations in Python and Data Analysis using Python

SYLLABUS

1. **Introduction to Python: Rapid Introduction to Procedular Programming, Data Types**: Identifiers and Keywords, Integral Types, Floating Point Types

Strings: Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, String formatting with str.format

Collections Data Types: Tuples, Lists, Sets, dictionaries, Iterating and copying collections

2. **Python Control Structures, Functions and OOP:Control Structures and Functions**: Conditional Branching, Looping, Exception Handling, Custom Fuctions

Python Library Modules: random, math, time, os, shutil, sys, glob, re, statistics,creating a custom module

Object Oriented Programming: Object Oriented Concepts and Terminology, Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access

File Handling: Writing and Reading Binary Data, Writing and Parsing Text Files

3. **NumPy Arrays and Vectorized Computation**: NumPy arrays, Array creation, Indexing and slicing, Fancy indexing, Numerical operations on arrays, Array functions, Data processing using arrays, Loading and saving data, Saving an array, Loading an array, Linear algebra with NumPy, NumPy random numbers

4. **Data Analysis with Pandas**: An overview of the Pandas package, The Pandas data structure-Series, The DataFrame, The Essential Basic Functionality: Reindexing and altering labels , Head and tail, Binary operations, Functional statistics , Function application Sorting, Indexing and selecting data, Computational tools, Working with Missing Data, Advanced Uses of Pandas for Data Analysis - Hierarchical indexing, The Panel data

5. **Data Analysis Application Examples**: Data munging,Cleaning data, Filtering, Merging data, Reshaping data, Data aggregation, Grouping data

6. **Data Visualization**: The matplotlib API primer-Line properties, Figures and subplots, Exploring plot types-Scatter plots, Bar plots, Histogram plots, Legends and annotations, Plotting functions with Pandas

Text Books :

1. Programming in Python 3: A Complete Introduction to Python Language, Mark Summerfield, Second Edition, Addison-Wesley Publications

2. Python: End-to-End Data Analysis Learning Path, Module 1: Getting Started with Python Data Analysis , Phuong VothiHong , Martin Czygan, , Packt Publishing Ltd

Reference Books :

1. Learning Python, 5th Edition, Mark Lutz, Orielly Publications

2. Python for Data Analysis, Wes McKinney, Orielly Publications

3. How to Think Like a Computer Scientist: Learning with Python 3 Documentation 3rd Edition, Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers

4. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall

5. Python Cookbook – Recipes for Mastering Python 3,3rdEdition, David Beazley, Brian K. Jones, Oreilly.

EC2103 : ANALOG COMMUNICATIONS

Course Objectives:

The objectives of this course are

* To familiarize with the fundamentals of analog communication systems

* To learn various techniques for analog modulation and demodulation of signals

* To develop the ability to classify and understand various functional blocks of radio transmitters and receivers

* To know basic techniques for generating and demodulating various pulse modulated signals.

Course Outcomes:

At the end of the course the student will be able to

* Understand the basic concepts of analog communication system and compare various amplitude modulation techniques with spectral characteristics.

* Differentiate the angle modulation schemes with linear modulation techniques.

* Categorize the noise behaviours of analog communication systems.

* Classify Radio transmitters and understand their performances.

* Classify Radio receivers and understand their performances.

* Compare the various analog pulse modulation systems.

SYLLABUS

Linear Modulation Systems: Need for Modulation, Frequency Translation, Method of Frequency Translation, Amplitude Modulation, Modulation Index, Spectrum of AM Signal, Modulators and Demodulators (Diode detector), DSB-SC Signal and its Spectrum, Balanced Modulator, Synchronous Detectors, SSB Signal, SSB Generation Methods, Power Calculations in AM Systems, Application of AM Systems.

Angle Modulation Systems: Angle Modulation, Phase and Frequency Modulation and their Relationship, Phase and Frequency Deviation, Spectrum of an FM Signal, Bandwidth of Sinusoidally Modulated FM Signal, Effect of the Modulation Index on Bandwidth, Spectrum of Constant Bandwidth FM, Phasor Diagram for FM Signals, FM Generation: Parameter variation method, Indirect method of Frequency Modulation (Armstrong Method), Frequency Multiplication, PLL FM Demodulator, Pre – emphasis and De – emphasis, Comparison of FM and AM.

Noise in AM and FM Systems: Sources of Noise, Resistor Noise, Shot Noise, Calculation of Noise in a Linear System, Frequency Domain representation of Noise, The effect of Filtering on the Probability density of Gaussian Noise, Effect of filter on the power spectral Density of Noise, Narrow Bandwidth, Quadrature components of Noise, Power spectral density of Noise, Probability Density of Noise and their time derivatives, representation of Noise using Orthonormal coordinates, Noise in AM Systems, Noise in Angle Modulation Systems, Comparison between AM and FM with respect to Noise, Threshold Improvement in Discriminators, Comparisons between AM and FM.

Radio Transmitters: Classification of Radio Transmitters, Principle of a Radio Transmitters, AM and FM Transmitters, Radio Telegraph and Radio Telephone Transmitters, SSB Transmitters.

Radio Receivers: Radio receiver Types, AM Receivers – RF Section, Frequency Changing and Tracking, Intermediate Frequency and IF Amplifiers, Automatic Gain Control (AGC); FM Receivers – Amplitude Limiting, FM Demodulators, Ratio Detectors, ISB Receiver, Comparison with AM Receivers, Extensions of the Super-heterodyne Principles, Additional Circuits.

Pulse Analog Modulation methods: Pulse Modulation techniques, Sampling, Types of Sampling and its analysis, Time division Multiplexing, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse position modulation, Pulse Code Modulation.

Text Books:

1. Principles of Communication Systems, H. Taub, D. L. Schilling and Glutamate, TMH 3rd edition, 2007.

2. Principle of Communication Systems, Simon Haykins (2nd Edition).

3. Electronic Communication Systems, G. Kennedy, McGraw Hill, 1977 (2nd Edition).

References:

1. Modern Digital and Analog Communication Systems, B. P. Lathi (2nd Edition).

2. Communication systems, R.P. Singh and S.D. Sapre 2nd edition TMH 2008

3. Electronic Communications Modulation and Transmission, Robert J. Schoenbeck, PHI N. Delhi, 1999.

EC2104 : SIGNALS AND SYSTEMS

Course Objectives:

The objectives of this course are

* To explain signals and systems representations/classifications and also describe the time and frequency domain analysis of continuous time signals with Fourier series.

* Fourier transforms and Laplace transforms.

* To understand Sampling theorem, with time and frequency domain analysis of discrete time signals with DTFS, DTFT and Z-Transform.

* To present the concepts of convolution and correlation integrals and also understand the properties in the context of signals/systems and lay down the foundation for advanced courses.

Course Outcomes:

At the end of the course the student will be able to

* Analyze the discrete time signals and system using different transform domain techniques.

* Design and implement LTI filters for filtering different real-world signals.

* Analyze the frequency domain representation of signals using CTFT and DTFT.

* Interpret signals and analyze system response using convolution integral and compute the correlation of signals.

* Understand the process of sampling and the effects of under sampling.

* Apply the Laplace transform and Z- transform for analyzing continuous-time and discrete - Time signals and systems.

SYLLABUS

Introduction to signals and linear time Invariant systems: Basic signals, elementary signals in continues and discrete domain, classification of signals, useful signal operations, discrete signal models, discrete signal operations, classification of systems, basic system properties, Casual LTI Systems Described by Differential and Difference Equations, unit impulse response of a system, system response to external input, classical solutions of difference equations, system stability.

Frequency analysis of continuous time signals : Fourier Series Representation of continuous time Periodic Signals, convergence of the Fourier Series, exponential Fourier series, Properties of continuous time Fourier Series, power density spectrum of periodic signals, representation of aperiodic signals, Fourier Transform, transform of some useful functions, Fourier Transform for periodic signals, theorems and properties of Fourier transforms, signal energy.

Frequency analysis of Discrete time signals :. Discrete time Fourier series(DTFS), properties of DTFS, power density spectrum of discrete periodic signals, representation of aperiodic signals, discrete time Fourier transform (DTFT),convergence of DTFT, DTFT theorems and properties, energy density spectrum of discrete aperiodic signals.

Convolution and correlation of signals: System analysis by Convolution, Convolution as a superposition of impulse response, some Convolution relationships, Graphical interpretation of Convolution, Convolution of a function with a unit impulse, Signal comparison, Correlation and Convolution, Some properties of correlation functions, Correlation functions for nonfinite energy signals, Detection of periodic signals in the presence of Noise by correlation, Determination of the waveform of a periodic signal masked by Noise, Extraction of a signal from Noise by filtering.

Laplace Transform: Introduction, The Laplace Transform, the region of convergence for Laplace Transforms, The Inverse Laplace Transform, Geometrical evaluation of the Fourier transform from the Pole-Zero plot, Properties of Laplace Transforms, the initial and Final value theorems, Analysis and characterization of LTI systems using the Laplace Transforms.

Sampling Theorem and Z-transform: sampling theorem, reconstruction of a signal from its samples using interpolation, The effect of Under sampling, aliasing, Discrete time processing of continuous time signals, sampling of Discrete time signals. unilateral Z-Transforms and bilateral

Z-Transforms, Properties of Z-Transform, relationship of the Fourier transform to the Z- transform, Inverse Z-Transform by contour integral, power series, partial fraction expansion. decomposing of rational Z-transform, causality and stability, the initial value theorem and final value theorem, some common Z-transform pairs, Analysis and characterization of LTI systems using the Z-Transforms.

Text Books:

1. Signals and Systems, Alan V. Oppenheim, Alan S. Will sky and Ian T. Young, PHI, 2ndEdn.

2. Signal Processing and Linear Systems , B. P. Lathi, Berkeley Cambridge Press.

3. Signals and Systems, K. Raja Rajeswari and B. V. Rao, Prentice Hall of India.

Reference Books:

1. Signals and Systems- Simon Haykin and Van Veen, Wiley 2ndEdn.

2. Signals and Systems – P. Ramesh Babu and R. Ananda Natarajan 3rd Edn.

EC2105 : MANAGERIAL ECONOMICS

Course Objectives:

The objectives of this course are

* To integrate the concept of price and output decisions of firms under various market structure.

* To impart the knowledge of economics as a subject and its importance while business.

* The business decisions are made scientifically on the basis of all available information.

* To familiarize the students with the basic concept of microeconomics.

* To understand the demand and supply analysis in business applications

* To familiarize with the production and cost structure under different stages of production.

Course Outcomes:

At the end of the course the student will be able to

* To understand the concepts of cost, nature of production and its relationship to Business operations.

* To apply marginal analysis to the "firm" under different market conditions.

* To analyze the causes and consequences of different market conditions.

* To integrate the concept of price and output decisions of firms under various market structure.

SYLLABUS

Significance of Economics and Managerial Economics: Economics: Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics. **Managerial Economics:** Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand Analysis: Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand -Assumptions and limitations. Exceptional demand curve. **Elasticity of demand** - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Demand Forecasting - Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods. **Utility Analysis:** Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations**.**

Theory of Production and Cost analysis: Production - Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law. **Cost analysis -** Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale.

Market Structures: Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly, Oligopoly, Importance of kinked demand curve; Monopolistic Competition.

Pricing Analysis: Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing, Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark-down pricing of retailers.

Business cycles, Inflation and Deflation: Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solve problems arising from Business cycles. **Inflation -**Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti- inflationary measures. **Deflation-** Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

Text Books:

1. Sankaran,S., Managerial Economics, Marghan Publications, 2015, Chennai.

2. Aryasri, A.R., Managerial Economics and Financial Analysis, MC Graw Hill Education, New Delhi,2015.

Reference Books:

1. Dwivedi, D.N., Managerial Economics, Vikhas Publishing House Pvt. Ltd. 6th Edition, New Delhi,2004.

2. Dewett, K.K., Modern Economic Theory, S. Chand & Company Ltd., New Delhi, 2005.

EC2106 : PYTHON PROGRAMMING LAB

Course Objectives :

* familiarize students with key data structures in Python including lists and dictionaries and apply them in context of searching, sorting, text and file handling

* introduce students to calculation of statistical measures using Python such as measures of central tendency, correlation

* familiarize students with important Python data related libraries such as Numpy and Pandas and use them to manipulate arrays and dataframes

* introduce students to data visualization in Python through creation of line plots, histograms, scatter plots, box plots and others

* implementation of basic machine learning tasks in Python including pre-processing data, dimensionality reduction of data using PCA, clustering, classification and cross-validation.

Course Outcomes :

After completion of the course the student should be able to:

* implement searching, sorting and handle text and files using Python data structures such as lists and dictionaries

* calculate statistical measures using Python such as measures of central tendency, correlation

* use Python data related libraries such as Numpy and Pandas and create data visualizations

* implement basic machine learning tasks pre-processing data, compressing data, clustering, classification and cross-validation.

SYLLABUS

1. Python Programs on lists & Dictionaries
2. Python Programs on Searching and sorting
3. Python Programs on Text Handling
4. Python Programs on File Handling
5. Python Programs for calculating Mean, Mode, Median, Variance, Standard Deviation
6. Python Programs for Karl Pearson Coefficient of Correlation, Rank Correlation
7. Python Programs on NumPy Arrays, Linear algebra with NumPy
8. Python Programs for creation and manipulation of DataFrames using Pandas Library
9. Write a Python program for the following.

* Simple Line Plots,
* Adjusting the Plot: Line Colors and Styles, Axes Limits, Labeling Plots,
* Simple Scatter Plots,
* Histograms,
* Customizing Plot Legends,
* Choosing Elements for the Legend,
* Boxplot
* Multiple Legends,
* Customizing Colorbars,
* Multiple Subplots,
* Text and Annotation,
* Customizing Ticks

10. Python Programs for Data preprocessing: Handling missing values, handling categorical data, bringing features to same scale, selecting meaningful features
11. Python Program for Compressing data via dimensionality reduction: PCA
12. Python Programs for Data Clustering
13. Python Programs for Classification
14. Python Programs for Model Evaluation: K-fold cross validation

Reference Books :

1. Core Python Programming, Second Edition, Wesley J. Chun, Prentice Hall
2. Chris Albon, “Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning”, O’REILLY Publisher,2018
3. Mark Summerfield, Programming in Python 3—A Complete Introduction to the Python Language, Second Edition, Additson Wesley
4. Phuong Vo.T.H , Martin Czygan, Getting Started with Python Data Analysis, Packt Publishing Ltd
5. Armando Fandango, Python Data Analysis, Packt Publishing Ltd
6. Magnus Vilhelm Persson and Luiz Felipe Martins, Mastering Python Data Analysis, Packt Publishing Ltd
7. Sebastian Raschka& Vahid Mirjalili, “Python Machine Learning”, Packt Publisher, 2017

EC2107 : ANALOG COMMUNICATIONS LAB

Course Objectives:

The objectives of this course are

* To understand all types of analog modulation / demodulation principles such as AM, SSB-SC, FM.

* To recognize the importance of pre-emphasis and de-emphasis.

* To design the filters using passive components.

* To Substantiate pulse modulation techniques.

Course Outcomes:

At the end of the course the student will be able to

* Generate, detect and analyze different amplitude modulation & demodulation techniques.

* Analyze and design various analog filters using passive components.

* Detect and Analyze frequency modulation & demodulation techniques.

* Construct pre-emphasis and de-emphasis at the transmitter and receiver respectively.

* Able to Analyze T – Type attenuator and Mixer characteristics.

SYLLABUS

List of Experiments:

1. AM Modulation and Demodulation
2. Low Pass Filter using passive components
3. High Pass Filter using passive components
4. Active Notch Filter
5. Frequency Modulation and Demodulation
6. Pre-emphasis and De-emphasis
7. T – Type attenuator
8. Band pass filter using passive components
9. Mixer characteristics
10. SSB-SC modulation and demodulation.

EC2108 : SIGNALS AND SYSTEMS SIMULATION LAB

Course Objectives:

* To provide background and fundamentals of MATLAB tool for the analysis and processing of signals and to generate various continuous and discrete time signals.

* To understand discrete signal design and analysis.

* To provide an overview of signal transmission through linear systems, convolution and correlation of signals and sampling.

* To understand signal representation in digital domain.

* To understand the concept and importance of Fourier and Z-Transforms

Course Outcomes:

Upon completion of this course, students will able to:

* **Design:** Generation of Various Signals and Sequences in MATLAB, including the operations on signals and sequences.

* **Verification** of Sampling Theorem, Linearity and Time Invariance Properties of a given Signals/ Systems.

* **Analyze** the Fourier Transform of a given signal and plotting its magnitude and phase spectrum and also plot Pole-Zero Maps in Z-Plane.

SYLLABUS

LIST OF EXPERIMENTS

1. Basic Operations on Matrices.

2. Write a program for Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit impulse, unit step, square, saw tooth, triangular, sinusoidal, ramp and sinc functions.

3. Write a program to perform operations like addition, multiplication, scaling, shifting, and folding on signals and sequences and computation of energy and average power.

4. Write a program for finding the even and odd parts of the signal / sequence and real and imaginary parts of the signal.

5. Write a program to perform convolution between signals and sequences.

6. Write a program to perform autocorrelation and cross correlation between signals and sequences.

7. Write a program for verification of linearity and time invariance properties of a given continuous/discrete system.

8. Write a program for computation of unit samples, unit step and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties.

9. Write a program to find trigonometric and exponential Fourier series coefficients of a rectangular periodic signal.

10. Write a program to find the Fourier transform of a given signal and plotting its magnitude and Phase spectrum.

11. Write a program for Sampling theorem and its verification.

12. Write a program for locating the zeros and poles and plotting the pole-zero maps in Z-plane for the given transfer function.

EC2109 : DIGITAL CIRCUITS SIMULATION

Course Objectives:

The objectives of this course are

* To Verify Logic gates

* To Verify Half adders and full adders

* To Design ripple counter and synchronous counter

* To simulate logic gates and flip flops, combinational and sequential circuits.

Course Outcomes:

At the end of the course the student will be able to

* Implement logic gates through VHDL and VERILOG programming

* Implement combinational and sequential circuits through VHDL and VERILOG programming.

* Implement the logic gates, full Adder, Decoder, Encoder, MUX and DeMUX in VHDL and VERILOG programming.

* Simulate and Analyze Flip-Flops, Shift Register and Counters using VHDL and VERILOG programming.

SYLLABUS

List of Experiments:

SIMULATION OF EXPERIMENTS THROUGH VHDL AND VERILOG PROGRAMMING LANGUAGES

1. Simulation of Logic gates
2. Simulation of Half adder and Full adder
3. Simulation of Multiplexer
4. Simulation of De-Multiplexer
5. Simulation of Decoder
6. Simulaiton of Encoder
7. Simulation of Flip flops (SR & D)
8. Simulation of Up-down counter& Shift register

Reference Books for VHDL & Verilog :

1. M.Morris mano & michael D.ciletti Digital Design: With An Introduction To The Verilog HDL, VHDL And System Verilog

2. Peter J. Ashenden: “Digital Design - An Embedded Systems Approach Using VHDL”

3. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition

4. John F.Wakerly “Digital Design Principles & Practices 4th Edition

5. SystemVerilog for Verification – Chris Spear

6. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition by Samir Palnitkar

Online Resources:

1.https://www.xilinx.com/products/design-tools/ise-design-suite.html

EC2110 : PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:

* To recognize the moral values that should guide the Engineering profession.

* To resolve moral issues concerning one’s profession.

* To develop and exhibit a set of moral beliefs and attitudes that engineers should inculcate.

* To inculcate social values and morality in one’s life.

* To develop awareness about Professional/Engineering Ethics and Human Values.

Course Outcomes :

Students will be able to:

* Apply the conceptual understanding of ethics and values into everyday practice.

* Understand the importance of moral awareness and reasoning in life.

* Acquire professional and moral etiquette that an engineer requires.

* Develop the acumen for self-awareness and self-development.

* Develop cultural tolerance and integrity.

* Tackle real-life challenges with empathy.

SYLLABUS

Unit - I: HUMAN VALUES : Values - Respect - Caring - Sharing - Honesty- Courage - Self confidence - Communal Harmony Morals - Virtues

Unit –II PROFESSIONAL VALUES : Integrity - Discipline - Valuing time - Cooperation - Commitment - Code of conduct - Challenges in the workplace

Unit – III PROFESSIONAL ETHICS : Overview - Engineering ethics - Moral issues - Profession - Models of professional roles - Responsibility

Unit – IV RESPONSIBILITIES AND RIGHTS : Safety and risk - Collegiality and loyalty - Confidentiality - Occupational crime - Human rights - Employee rights - Intellectual property rights

Unit – V GLOBAL ISSUES : Globalization - Environmental ethics - Computer ethics - Code of ethics - Multinational corporations - Engineers as advisors in Planning and Policy making

Textbook:

1.R.S. Nagarazan. A Textbook on Professional Ethics and Human Values. New Age International Publishers. 2006.

Reference Books:

1. Premvir Kapoor. Professional Ethics and Human Values. Khanna Publishing House. 2019.

2. B.S. Raghavan. Human Values and Professional Ethics. S.Chand Publications. 2012.

3. R.R. Gaur & Others. A Foundation Course in Human Values and Proff. Ethics. Excel Books. 2009.

4. A. N. Tripathi. Human Values. New Age International (P) Limited. 2009

5. R. Subramanian. Professional Ethics. OUP India. 2013.

EC2111 NCC/NSS

EC2201 PROBABILITY THEORY AND RANDOM PROCESS

Course Objectives:

The objectives of this course are

* To understand the concept of Bayes' theorem

* To learn about operations on single and multi-random variables.

* To find the cross correlation and autocorrelation of signals

* To learn about various types of oscillators

Course Outcomes:

At the end of the course the student will be able to

* Compute probabilities and conditional probabilities of events defined on a sample space.

* Compute statistical averages of one random variable using probability density and distribution functions and also transform random variables from one density to another

* Identify different types of random variables and compute statistical aver-ages of these random variables using probability density and distribution func- tions and also perform multiple transformations of multiple random variables.

* Determine stationarity and ergodicity and compute correlation and covariance of a random process.

* Compute and sketch the power spectrum of the response of a linear time-invariant system excited by a band pass/band-limited random process

SYLLABUS

Probability Theory: Sample spaces, Events, Probability definition and Axioms, Mathematical model of experiments, Probability as relative frequency, Joint and conditional probability, Properties of joint probability and conditional probability, Total probability, Bayes' theorem, independent events: Two events and multiple events, properties of independent events.

Random Variables and Operations on one random variable: Random variable concept, Distribution function, Density function, Gaussian random variable, Conditional distribution and density function, Expectation, Moments, Functions that give moment, Transformations of a random variable.

Multiple random variables: Vector random variables, Joint distribution and its properties, Joint density and its properties, Conditional distribution and density, statistical independence, Distribution and density of a sum of random variables, Central limit theorem.

Operations on multiple random variables: Expected values of a function of random variables: Joint moments about the Origin, joint central moments, Joint characteristic functions, Jointly Gaussian random variables: Two random variables, n-random variables, properties of Gaussian random variables, Transformations of multiple random variables: One function, Multiple functions, Inequalities of Chebyshev and Schwartz.

Random Processes: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence, First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Function and their properties, Weiner-Kin chine Theorem ,Gaussian Random Processes, Poisson Random Process.

Linear Systems with Random Inputs: System Response – Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, Band pass, Band-Limited and Narrowband Processes.

Text Books:

1. Probability Theory and Random Signal Principles, Peyton Z. Peebles, 4th edition Tata McGrew Hill Publishers,2002.

2. Probability Theory and Random Processes, S. P. Eugene Xavier, S. Chand and Co. New Delhi, 1998 (2nd Edition).

Reference Books:

1. Fundamentals of Applied Probability and Radom processes, Oliver Crib, Elsevier Publications, 2007.

2. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002.

3. Probability theory and Stochastic Processes, B. PrabhakaraRao, T.S.R. Murthy, BS Publications, Hyderabad, 2012.

EC2202 : ELECTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES

Course Objectives:

The objectives of this course are

* To Define the Basic Electrostatic and Magneto static Law Derive the Maxwell's Equation and apply to the basic electromagnetic problem.

* To Analyze the boundary conditions, at the interface of two different media and also time varying electric and magnetic fields.

* To Explain the wave propagation in different types of mediums and also transmission line fundamentals.

* To Demonstrate the smith chart-configuration.

Course Outcomes:

At the end of the course the student will be able to

* To evaluate the design and problem-solving skills

* Able to define electrostatic and magneto static laws

* Able to derive the Maxwell's equations in static and dynamic fields

* Able to describe energy density on electric/magnetic fields' and poynting theorem.

* Able to analyze the EM wave propagation in different mediums

* Able to relate the wave propagation through transmission lines and compute the impedance using smith chart for matching the load impedance.

SYLLABUS

Electrostatics: Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Energy density, Convection and Conduction Currents, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations; Capacitance.

Magneto statics: Biota-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Inductances and Magnetic Energy.

Maxwell's Equations: Faraday's Law and Transformer emf, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Conditions at a Boundary Surface: Dielectric-Dielectric and Dielectric-Conductor Interfaces. Related Problems.

Electromagnetic Waves: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Polarization, Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance. Poynting Vector and Poynting Theorem

Transmission Lines: Introduction to Transmission line equations, Primary & Secondary constants Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Loss lessness /Low Loss Characterization, Distortion, Loading, SC and OC Lines, Reflection Coefficient, VSWR, ë/8, ë/4, ë/2-line impedance Transformations, Smith Chart – Configuration and Applications.

Waveguides: Introduction, Rectangular Waveguides, electric and magnetic field patterns in TE10 and TE11 mode configuration, modes of TE wave in rectangular waveguide, field equations, impossibility of TEM wave propagation in waveguides, cutoff frequency of rectangular waveguide, propagation constant, wave impedance, phase velocity, group velocity, dominant mode and degenerate modes, related problems.

Text Books:

1. Electromagnetic Field Theory and Transmission Lines, Gottapu Sasibhushana Rao, Wiley India Pvt. Ltd., New Delhi, 1st Ed.,2012.

2. Electromagnetics with Applications, Kraus and Flesch, McGraw Hill, 1999.

3. Electromagnetic Field Theory and Transmission Lines, G.S.N. Raju, Pearson Education (Pvt., Ltd., New Delhi, 2005.

Reference Books:

1. Elements of Electromagnetic – Matthew N.O. Sadiku, Oxford Univ. Press, 3rd ed., 2001.

2. Engineering Electromagnetics, W. H. Hayt Jr., McGraw Hill – New York.

3. EM Waves and Radiating Systems, E. C. Jordan, PHI, 1997.

EC2203 : MICROPROCESSORS AND MICRO CONTROLLERS

Course Objectives:

The objectives of this course are

* To know the internal organization, addressing modes and instruction sets of 8086 processor.

* To master the assembly language programming using concepts like assembler directives, procedures, software interrupts etc.

* To familiarize with the 8051 Instruction sets and addressing modes.

* To know the various peripheral devices such as 8255, 8279, 8251 and 8259.

Course Outcomes:

At the end of the course the student will be able to

* Realize the architecture and working of 16-bit microprocessor 8086.

* Apply assembly language programming skills to perform arithmetic, logical, string, stack and interrupt operations with 8086.

* Understand the interfacing of memory and different peripherals with 8086 microprocessors.

* Outline the architectural features of advanced microprocessors.

* Summarize the basic concepts of 8051 microcontroller.

* Comprehend the architecture and instruction set of PIC and ARM microcontroller.

SYLLABUS

8086/8088 Microprocessors: Register organization of 8086, Architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special purpose activities, Minimum mode, maximum mode of 8086 system and timings, the processor 8088, machine language instruction formats, addressing mode of 8086, instruction set off 8086, assembler directives and operators.

Programming With 8086 Microprocessors: Machine level programs, programming with an assembler, Assembly language programs, introduction to stack, stack structure of 8086/8088, interrupts and interrupt service routines, interrupt cycle of 8086, non-mask able interrupt and mask able interrupts, interrupt programming.

Basic And Special Purpose Programmable Peripherals And Their Interfacing With 8086/88: Semiconductor memory interfacing, dynamic RAM interfacing, interfacing i/o ports, PIO 8255 modes of operation of 8255, interfacing to D/A and A/D converters, stepper motor interfacing, control of high power devices using 8255.Programmable interrupt controller 8259A, the keyboard /display controller8279, programmable communication interface 8251 USART, DMA Controller 8257.

Advanced Micro Processors: Salient features of 0386DX, architecture and signal description of 80386, register organization of 80386 and addressing modes, data types of 80386, real address mode of 80386, protected mode of 80386, segmentation and Paging, virtual 8086 mode and enhanced mode. Instruction set of 80386.The coprocessor 80387.

8051 Microcontrollers: Introduction to microcontrollers, 8051 Microcontrollers, 8051pin description, connections, I/O ports and memory organization, MCS51addressing modes and instructions, assembly language programming tools.

PIC Microcontrollers and ARM 32-BIT Microcontroller: Overview and features, PIC16Cx/7X instructions, interrupts in PIC 16C61/71, PIC 16F8XX Flash controllers, I/O ports and timers. Introduction to 16/32 Bit processors, ARM architecture and organization, ARM / Thumb programming model, ARM / Thumb instruction set.

Text Books:

1. A.K. Ray, K.M. Bhurchandi," Advanced Microprocessors and Peripherals", Tata McGraw Hill Publications, 2000.

2. N. Sentil Kumar, M. Saravanan, S. Jeevananthan, "Microprocessors and Microcontrollers", OxfordUniversity Press, 2010.

Reference Books:

1. Ajay V Deshmukh," Microcontrollers", TATA McGraw Hill publications, 2012.

2. Krishna Kant, "Microprocessors and Microcontrollers", PHI Publications, 2010.

EC2204 : LINEAR ICS & APPLICATIONS

Course Objectives:

The objectives of this course are

* To understand & learn the measuring techniques of performance parameters of OP- AMP.

* To learn the linear and non-linear applications of operational amplifiers.

* To understand the analysis & design of different types of active filters using op-amps.

* To learn the internal structure, operation and applications of different analog ICs.

* To Acquire skills required for designing and testing integrated circuits.

Course Outcomes:

At the end of the course the student will be able to

* Outline the fundamental concepts of an operational amplifier.
* Make use of an op-amp to design linear and non-linear circuits.
* Analyze and design Signal Conditioning Circuits using op-amp.
* Analyze and design active filters using op-amp.
* Develop timers and PLL's by making use of 555 and 565 linear IC's.
* Differentiate various types of DAC's and ADC's using op-amp.

SYLLABUS

Operational Amplifiers: Design Aspects of Monolithic Op-Amps, Ideal Characteristics, AC and DC Characteristics, Data sheet Specifications, Offset Voltages and Currents, Frequency Compensation Techniques, Measurement of Op-Amp Parameters.

Applications of Op-Amps: Inverting and Non-inverting Amplifiers, Integrator, Differentiator, Comparator, Logarithmic Amplifiers, Instrumentation Amplifiers, Op-Amp Phase Shift, Wein-bridge and Quadrature Oscillator, Voltage Controlled Oscillators, Voltage to Current and Current to Voltage Converters., Analog Multiplexers.

Signal Conditioning Circuits: Rectifiers, Peak Detection and, Wave form Generators, Sample and Hold Circuits, Multivibrators, Square Wave Generators, Schmitt trigger.

Active Filters: LPF, HPF, BPF, BEF, All-pass Filters, Higher Order Filters and their Comparison, Switched Capacitance Filters.

Special ICs: 555 Timers, 556 Function Generator ICs and their Applications, Three Terminal IC Regulators, IC 1496 (Balanced Modulator), IC 565 PLL and its Applications, Function Generators, Voltage to Frequency and Frequency to Voltage Converters.

Digital to Analog and Analog to Digital Converters: DAC techniques, Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Different types of ADCs-parallel Comparator type ADC, Counter type ADC, Successive approximation ADC and dual type ADC, DAC and ADC specifications, Integrated ADC and DACs.

Text Books:

1. Ramakant A. Gayakwad, ¯OP-AMP and Linear ICs , 4th Edition, Prentice Hall / Pearson Education, 2015.

2. Linear Integrated Circuits- D. Roy Chowdhury, New Age International(p) Ltd,2nd Edition, 2003.

Reference Books:

1. Integrated Circuits- Botkar, Khanna Publications, Edition 2008.

2. Applications of Linear ICs- Clayton, Publisher: Macmillan Education UK, Year: 1978.

3. S.Salivahanan & V.S. Kanchana Bhaskaran, ¯Linear Integrated Circuits , TMH,2nd Edition, 4 th Reprint, 2016.

4. Operational Amplifiers & Linear Integrated Circuits: Theory and Application / 3E by James M. Fiore Version 3.2.6, 2021.

EC2205 : PULSE AND DIGITAL CIRCUITS

Course Objectives:

The objectives of this course are

* To understand the concept of wave shaping circuits, Switching Characteristics of diode and transistor.
* To study the design and analysis of various Multivibrators.
* To understand the functioning of different types of time-base Generators.
* To learn the working of logic families.

Course Outcomes:

At the end of the course the student will be able to

* Outline the response of linear wave shaping circuits for the standard inputs.
* Extend the applications of diodes and transistors to non-linear wave shaping.
* Understand the operation, analysis and design of Bistable multivibrators using BJTs.
* Make use of basic electronic components to design monostable and astable multivibrators.
* Categorize the operation of various time base generators.
* Realization of logic gates using different logic families.

SYLLABUS

Linear Wave Shaping: High pass and Low pass RC circuits, Response of High pass and Low pass RC circuits to sinusoidal, step, pulse, square, exponential and Ramp inputs, High pass RC circuit as a differentiator, Low pass RC circuit as an integrator. Attenuators and its application as CRO probe, RL and RLC Circuits and their response for step input, Ringing Circuit.

Nonlinear Wave Shaping: Diode clippers, Transistor Clippers, clipping at two independent levels, Comparator, Applications of voltage Comparators, Diode Comparator, Clamping Operation, Clamping Circuits using Diode with Different Inputs, Clamping Circuit Theorem, Practical Clamping circuits, Effect of diode Characteristics on Clamping Voltage.

Bistable Multivibrators: Transistor as a switch, switching times of a transistor, Design and Analysis of Fixed-bias and self-bias transistor binary, commutating capacitors, Triggering schemes of Binary, Transistor Schmitt trigger and its applications.

Monostable and Astable Multivibrators: Design and analysis of Collector coupled Monostable Multivibrator, Expression for the gate width and its waveforms. Design and analysis of Collector coupled Astable Multivibrator, expression for the Time period and its waveforms, The Astable Multivibrator as a voltage to frequency convertor.

Time Base Generators: General features of a time-base signal, Methods of Generating time base waveform, Exponential voltage sweep circuit, Basic principles of Miller and Bootstrap time base generators, transistor Miller sweep generator, transistor Bootstrap sweep generator, Current Sweep circuit, Linearity correction through adjustment of driving Waveform.

Synchronization And Frequency Division: Principles of Synchronization, Frequency division in sweep circuit, Synchronization of A stable Multivibrators, Synchronization of a sweep circuit with symmetrical signals, Sine wave frequency division with a sweep circuit.

LOGIC GATES: Realization of gates using diodes and Transistors, RTL, DTL.

Text Books:

1. Pulse Digital and Switching Waveforms, J. Millman and H. Taub, McGraw-Hill, 2nd Edition 1991.

2. Pulse switching and digital circuits – David A. Bell, PHI ,5thEdn., oxford university press.

References Books:

1. Pulse and Digital Circuits, K. VenkatRao, Pearson Education India, 2nd Edition, 2010.

2. Pulse and Digital Circuits, A. Anand Kumar, PHI, second edition, 2005.

EC2206 : MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Objectives:

The objectives of this course are

* To study programming based on 8086 microprocessor and 8051 microcontrollers.

* To study 8086 microprocessor-based ALP using arithmetic, logical and shift operations.

* To study modular and Dos/Bios programming using 8086 microprocessors.

* To study to interface 8086 with I/O and other devices.

* To study parallel and serial communication using 8051 microcontrollers.

Course Outcomes:

At the end of the course the student will be able to

* Build basic assembly language programs based on arithmetic operations using 8086 microprocessors.

* Develop basic assembly language programs based on arithmetic, logical, shift and string operations using MASM32 assembler.

* Execution of DOS/BIOS interrupts with 8086 microprocessors using MASM32 assembler.

* Implementing basic assembly language programs of 8051 microcontroller using KEIL simulator.

* Construct standalone applications by Interfacing I/O peripheral devices with 8086 microprocessors.

SYLLABUS

List of Experiments:

8086 ESA-86/88 KIT PROGRAMMING

1. Write a Program to add two 16-bit numbers stored in two memory locations 2000h and 2002h and store the result in another memory location 2004h.

2. Write a Program to divide two 16-bit numbers stored in two memory locations 2000h and 2002h and store the result in another memory location 2004h.

3. Write a Program to multiply two 16-bit numbers stored in two memory locations 2000h and 2002h and store the result in another memory location 2004h.

4. Write a Program to add two 32-bit numbers stored in two memory locations 2000h and 2004h and store the result in another memory location 2008h.

5. Write a program to find factorial of a given number. 8086 PROGRAMMING USING MASM32 ASSEMBLER

6. Write a program to perform addition operation on two multi byte numbers.

7. Write a program to perform subtraction operation on two multi byte numbers.

8. Write a program to sort a given set of hexadecimal numbers.

9. Write a program to find whether the given string is a palindrome or not.

10. Write a program for inserting an element at a specified location in a given string.

11. Write a program to convert BCD numbers into equivalent binary value. Write a subroutine for the conversion.

12. Write a program to read a keyboard and display the characters on the PC screen using DOS/BIOS commands.

8051 PROGRAMMING USING KEIL SIMULATOR

13. Write a program to generate a square wave of 50% duty cycle at pin P2.1 using timer 0 in mode1.Assume XTAL=11.0592MHz.

14. Write a program to send a message "WELCOME" serially at 9600 baud rate continuously through serial port of 8051.

EC2207 : LINEAR ICS & PULSE CIRCUITS LAB

Course Objectives:

The objectives of this course are

* To apply operational amplifiers in linear and nonlinear applications.

* To acquire the basic knowledge of special function ICs.

* To Gain the practical hands-on experience on 555 Timer applications.

* To Gain the practical hands-on experience on 723 Voltage Regulator and Three terminal voltage regulators.

Course Outcomes:

* Design various linear & non-linear wave shaping circuits.

* Basic characteristics of op-amp parameters and its measurements, design compensating circuits.

* Develop applications using linear and nonlinear characterization of OPAMP.

* Understand the functionality of IC723 and determine the load and line regulations

* Design the Multivibrator circuits using IC555.

SYLLABUS

List of Experiments:

1. Linear wave shaping
2. Non-linear wave shaping
3. UJT as a Relaxation oscillator
4. Measurement of parameters of Op-amp
5. Schmitt trigger
6. Frequency response of Active filters
7. Op-amp as Wave form generator
8. IC-555 as an Astable Multi vibrator
9. Study of Instrumentation Amplifier
10. Voltage regulator using IC-723
11. Monostable Multi vibrator using IC-555.
12. Bistable Multi vibrator using transistors.

EC2208 : ELECTRONIC CIRCUITS SIMULATION

Course Objectives:

The objectives of this course are

* To Verify Electronic devices and Circuits experiments.

* To Verify Analog Electronics and Circuits experiments.

* To Verify Analog Communication experiments

* To Verify Digital Communication experiments.

Course Outcomes:

At the end of the course the student will be able to

* Implement electronic circuits through Multisim.

* Implement Analog electronic circuits through Multisim.

* Implement Analog communication experiments through LABVIEW.

* Implement Digital communication experiments through LABVIEW

SYLLABUS

Electronic Devices and Circuits Experiments:

1. Study and plot VI Characteristics of a Zener Diode, using MULTISIM
2. Design, Construct and Test a Full Wave Rectifier using diode and to draw its performance characteristics, MULTISIM
3. Study and plot Input and output characteristics of a Bipolar Junction Transistor (BJT) in Common Emitter (CE) configuration, MULTISIM
4. Study and plot the Drain and Transfer characteristics of a Junction Field Effect Transistor, MULTISIM
5. Study and plot Input and output characteristics of a Bipolar Junction Transistor (BJT) in Common Emitter (CB) configuration, MULTISIM

Analog Electronics & Circuits Experiments:

1. Common emitter and common source Amplifier
2. Two stage RC coupled Amplifier
3. RC Phase shift oscillator using transistors
4. Class-B Push pull Amplifier

5. Construct and Test Clipper & Clamper using discrete components, MULTISIM Analog communication and Digital communication Experiments:

1. Using Lab-View software simulates AM modulation and demodulation system

2. Using Lab-View software simulate FM modulation and demodulation system

3. Observe the process of Pulse Amplitude Modulation and Demodulation

4. Analyze the process of frequency division multiplexing and frequency division demultiplexing.

5. Study of quantization and PCM technique

EC2209 : ENVIRONMENTAL SCIENCE

Course Objectives:

The objectives of this course are

* To Familiarize the fundamental aspects of environment and the environmental management.

* To Provide information of some of the important international conventions which will be useful during the future endeavors after graduation.

* To Make realize the importance of natural resources management for the sustenance of the life and the society.

* To Apprise the impact of pollution getting generated through the anthropogenic activities on the environment.

* To Provide the concept of Sustainable Development, energy and environmental management.

* To Impart knowledge on the new generation waste like e-waste and plastic waste.

Course Outcomes:

At the end of the course the student will be able to

* Knowledge on the fundamental aspects of environment and the environmental management.

* The knowledge on the salient features of the important international conventions.

* Understanding of the importance of natural resources management for the sustenance of the life and the society.

* Familiarity on various forms of pollution and its impact on the environment.

* Understand the elements of Sustainable Development, energy and environmental management.

* Knowledge on the new generation waste like e-waste and plastic waste.

SYLLABUS

Introduction: Structure and functions of Ecosystems-Ecosystems and its Dynamics-Value of Biodiversity-impact of loss of biodiversity, Conservation of bio-diversity. Environmental indicators - Global environmental issues and their impact on the ecosystems.

Salient features of international conventions on Environment: Montreal Protocol, Kyoto protocol, Ramsar Convention on Wetlands, Stockholm Convention on Persistent Organic Pollutants, United Nations Framework Convention on Climate Change (UNFCCC),

Natural Resources Management: Importance of natural resources management-Land as resource, Land degradation, Soil erosion and desertification, Effects of usage of fertilizer, herbicides and pesticide- watershed management.

Forest resources: Use and over-exploitation, Mining and dams – their effects on forest ecosystems and the living beings.

Water resources: Exploitation of surface and groundwater, Floods, droughts, Dams: benefits and costs.

Mineral Resources: Impact of mining on the environment and possible environmental management options in mining and processing of the minerals. Sustainable resource management (land, water, and energy), and resilient design under the changing environment.

Environmental Pollution: Local and Global Issues. Causes, effects and control measures. Engineering aspects of environmental pollution control systems.

Air pollution: impacts of ambient and indoor air pollution on human health. Water pollution: impacts water pollution on human health and loss of fresh water resources. Soil pollution and its impact on environment. Marine pollution and its impact on blue economy. Noise pollution.

Solid waste management: Important elements in solid waste management- Waste to energy concepts. Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act and their amendments. Salient features of Environmental protection Act, 1986.

Sustainable Development: Fundamentals of Sustainable Development– Sustainability Strategies and Barriers – Industrialization and sustainable development. Circular economy concepts in waste (solid and fluid) management.

Energy and Environment: Environmental Benefits and challenges, Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Solar Energy: process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles,

working and applications, disposal of solar panel after their usage. Biomass energy: Concept of biomass energy utilization, types of biomass energy, con- version processes, Wind Energy, energy conversion technologies, their prin- ciples, equipment and suitability in context of India.

Management of plastic waste and E-waste: Sources, generation and characteristics of various e- and plastic wastes generated from various indus- trial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste process- ing alternatives. E-Waste management rules and Plastic waste management rules, 2016 and their subsequent amendments.

Text Books:

1. Bharucha, Erach (2004). Textbook for Environmental Studies for Un- dergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi.

2. Base, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India

3. Masters, G. M., &Ela, W. P. (1991). Introduction to environmental engi- neering and science. Englewood Cliffs, NJ: Prentice Hall.

4. Enger, E. and Smith, B., Environmental Science: A Study of Interrela-tionships, Publisher: McGraw-Hill Higher Education; 12th edition, 2010.

Reference Books:

1. Sharma, P. D., & Sharma, P. D. (2005). Ecology and environment.Rastogi Publications

2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

3. Clark R.S. (2001). Marine Pollution, Clanderson Press Oxford (TB)

4. Jadhav, H & Bhosale, V.M. (1995). Environmental Protection and Laws.Himalaya Pub. House, Delhi 284 p.

5. MoEF&CC, Govt. of India, CPCB: E-waste management rules, 2016and its amendments 2018.

6. MoEF&CC, Govt. of India, CPCB: Plastic waste management rules,2016.