B.TECH

(ELECTRONICS AND COMMUNICATION ENGINEERING)

(Effective from the admitted batch of 2021-22)

Scheme and Syllabus

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

AU COLLEGE OF ENGINEERING

ANDHRA UNIVERSITY

VISAKHAPATNAM

ANDHRA UNIVERSITY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Programme Educational Objectives

• PEO 1: To provide students an in-depth knowledge in the fundamental and advanced areas of electronics and communication engineering and there by excel in professional career and/or higher education.

• PEO 2: To train students in the software/hardware design of electronics and communication systems and can promote the development of research activity as well as interaction with the industry.

• PEO 3: To inculcate in students professional and ethical attitude, and an ability to relate engineering issues to broader social context.

Programme Outcomes: The Programme Outcomes are as follows:

PO1. Ability to apply knowledge of mathematics, science, and engineering.

PO2. Ability to design and conduct experiments, as well as to analyse and interpret data.

PO3. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO4. Ability to function on multi-disciplinary teams.

PO5. Ability to identify, formulate and solve engineering problems.

PO6. Understanding of professional and ethical responsibility.

PO7. Ability to communicate effectively.

PO8. Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO9. Recognition of the need for, and an ability to engage in life-long learning.

PO10. Knowledge of contemporary issues.

PO11. Ability to utilize experimental, statistical and computational methods and tools necessary for engineering practice.

PO12. Graduateswill demonstrate an ability to design Electronics and Communication Circuits, Antennas Design, Microwave Engineering, Wireless Communications & Signal Processing to analyse and interpret data and also an ability to design digital and analog systems and programming them.

Programme Specific Outcomes:

• PSO1: Apply the knowledge of Electronics & Communication Engineering principles in the field of Electronics, Signal processing , Communication, VLSI, Embedded system & Control Engineering.

• PSO2: Demonstrate proficiency in use of software and hardware required in real life applications.

• PSO3: Demonstrate the leadership qualities and strive for the betterment of organization, environment and society

SCHEME AND SYLLABI
(with effect from 2021-22)

B.Tech & B.Tech+M.Tech
I Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC1101	BS	Mathematics – I	4	0	30	70	100	3
EC1102	BS	Physics	4	0	30	70	100	3
EC1103	ES	Engineering Graphics	2	3	30	70	100	3
EC1104	ES	Electronic Devices and Circuits	4	0	30	70	100	3
EC1105	ES	Network Theory Analysis	4	0	30	70	100	3
EC1106	ES	Workshop	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**

B.Tech & B.Tech+M.Tech
I Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC1201	BS	Mathematics – II	4	0	30	70	100	3
EC1202	BS	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	Switching Theory and Logic Design	4	0	30	70	100	3
EC1206	HSS	English Language Lab	0	3	50	50	100	1.5
EC1207	BS	Chemistry 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**

B.Tech & B.Tech+M.Tech
II Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC2101	BS	Mathematics -III	4	0	30	70	100	3
EC2102	PC	Analog Electronic Circuits	4	0	30	70	100	3
EC2103	PC	Electrical Machines	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	Networks and Machine Lab	0	3	50	50	100	1.5
EC2107	PC	Analog Electronics and Circuits Lab with Simulation	0	3	50	50	100	1.5
EC2108	PC	Digital ICs and HDL Lab	0	3	50	50	100	1.5
EC2109	SC	Programming skills for problem solving	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**

B.Tech & B.Tech+M.Tech
II Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC2201	ES	Mathematics -IV	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	Probability theory and Random Process	4	0	30	70	100	3
EC2205	PC	Analog Communications	4	0	30	70	100	3
EC2206	PC	Microprocessors & Microcontrollers Lab	0	3	50	50	100	1.5
EC2207	PC	Analog Communications Lab	0	3	50	50	100	1.5
EC2208	SC	Python Programming	1	2	50	50	100	2
EC2209	MC	Environmental Science	0	0	00	100	100	0
							Total Credits	**20**
Internship-I								

B.Tech & B.Tech+M.Tech
III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC3101	PC	Linear ICs & Applications	4	0	30	70	100	3
EC3102	PC	Digital Communications	4	0	30	70	100	3
EC3103	PC	Pulse and Digital Circuits	4	0	30	70	100	3
EC3104	PE	Professional Elective-I	4	0	30	70	100	3
EC3105	OE	Open Elective-I	4	0	30	70	100	3
EC3106	PC	Linear ICs & Pulse Circuits Lab	0	3	50	50	100	1.5
EC3107	PC	Digital Communication Lab	0	3	50	50	100	1.5
EC3108	SC	Object Oriented Programming through JAVA	1	2	50	50	100	2
EC3109	INT	Internship-I			50	50	100	2
							Total Credits	**22**

B.Tech & B.Tech+M.Tech
III Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC3201	PC	Antennas and Wave Propagation	4	0	30	70	100	3
EC3202	PC	Digital Signal Processing	4	0	30	70	100	3
EC3203	PC	Microwave Engineering	4	0	30	70	100	3
EC3204	PE	Professional Elective-II	4	0	30	70	100	3
EC3205	OE	Open Elective-II	4	0	30	70	100	3
EC3206	PC	Antenna Simulation Laboratory	0	3	50	50	100	1.5
EC3207	PC	Digital Signal Processing Lab	0	3	50	50	100	1.5
EC3208	PC	Microwave Engineering Lab	0	3	50	50	100	1.5
EC3209	SC	Soft Skills	1	2	50	50	100	2
							Total Credits	**21.5**
Internship-II								

B.Tech & B.Tech+M.Tech
IV Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EC4101	PE	Professional Elective-III	4	0	30	70	100	3
EC4102	PE	Professional Elective-IV	4	0	30	70	100	3
EC4103	PE	Professional Elective-V	4	0	30	70	100	3
EC4104	OE	Open Elective-III	4	0	30	70	100	3
EC4105	OE	Open Elective-IV	4	0	30	70	100	3
EC4106	HSSE	HSS-Elective	4	0	30	70	100	3
EC4107	SC	Internet of Things Lab	1	2	50	50	100	2
EC4108	INT	Internship-II			50	50	100	2
							Total Credits	**22**

B.Tech & B.Tech+M.Tech
IV Year - II Semester

Course code	Category	Course Title	Internal Marks	External Marks	Total Marks	Credits
EC4201	PROJ	Project work	100	100	200	14
					Total Credits	**14**

PROFESSIONAL ELECTIVES

1. Global Positioning System
2. Radar Engineering
3. Cellular Mobile Communication
4. Electronic Measurements and Instrumentation
5. Micro Electronics
6. EMI/EMC
7. Internet and Web Technology
8. Information Theory and Coding
9. Smart Antenna Systems
10. TV and Satellite Communication System
11. Transducers and Signal Conditioning
12. Low Power VLSI Design
13. Digital Image Processing
14. Fiber Optic Communication
15. Advanced Microprocessors

OPEN ELECTIVES

1. VLSI Design
2. Wireless Sensor Networks
3. Computer Networks
4. DSP Processors and Architectures
5. Embedded System Design
6. Bio-Medical Instrumentation
7. Mobile Communications
8. FPGA Design
9. Speech Processing
10. Control Systems
11. Internet of Things and Applications
12. Artificial Neural Networks

HSS ELECTIVES

1. Industrial Management & Entrepreneurship
2. Organizational Behavior
3. Operations Research

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.

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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

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EC1103 ENGINEERING GRAPHICS

Course Objectives: The objectives of this course are

- To Understand the basics of Engineering Graphics and BIS conventions.
- To Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.
- To Demonstrate and practice the various profiles/curves used in engineering practice through standard procedures.
- To Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids.
- To Demonstrate and practice the development of surfaces of simple solids.
- To Familiarize the basic concept of isometric views clearly.

Course Outcomes: At the completion of the course the student will be able to

- Able toDevelop simple engineering drawings by considering BIS standards.
- Able to draw different engineering curves with standard Procedures.
- Able to Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.
- Able to Visualize clearly the sections of solids.
- Able to Apply the concepts of development of surfaces while designing/analyzing any product.
- Able to Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

SYLLABUS

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales. **Curves:** Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants. **Projections of Straight Lines:** Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.

Projections of Straight Line Inclined to Both the Reference Planes: Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views: Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

Text Book:

1. Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House.

Reference Books:

1. Engineering Graphics by K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill

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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 and its Application.

Junction diode characteristics: 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, Zener and Avalanche Breakdowns, Tunnel Diode, LED, Schottky Barrier Diode, Varactor Diode, Photo Diode, PIN Diode, Point Contact Diode.

Rectifier Circuits: Diode Rectifiers: Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Ripple Factor and Regulation Characteristics.

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, α and β Parameters and the relation between them, Photo Transistor, various Biasing circuits, stabilizations, thermal runaway, thermal stability, Transistor series and shunt voltage regulators.

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

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.

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. Electronic Devices and Circuits 2nd Edition, B. V. Rao and K. Raja Rajeswari, Pearson Education.

2. Electronic Devices and Circuits, K. Venkat Rao, K. Rama Sudha, McGraw Hill education, Edition-2015.

3. Electronic Devices and Circuits Theory, Boylsted and Nashelsky, Prentice Hall Publications.

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EC1105 NETWORK THEORY ANALYSIS

Course Objectives: The objectives of this course are

- To understand the Principles of Electrical Network Analysis.
- To understand the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal analysis techniques.
- To analyze circuits in time and frequency domain.
- To analyze the concepts of open circuit, short circuit, transmission, hybrid parameters and their interrelationship.
- To apply how to synthesize the network using passive elements.

Course Outcomes: At the completion of the course the student will be able to

- Apply concepts of electric network topology, nodes, branches, loops to solve circuit problems.
- Apply time and frequency concepts of analysis.
- Synthesize the network using passive elements.
- Distinguish various parameters and their interrelationship.
- Solve numerical problems with series, parallel and cascade connections using two port networks.
- Analyze and design simple electrical networks.

SYLLABUS

Analysis of DC Circuits: Active elements, Passive elements, Reference directions for current and voltage, Kirchhoff's Laws, Voltage and Current Division Nodal Analysis, Mesh analysis, Linearity and superposition, Thevinin's theorem and Norton's theorem, Reciprocity theorem, Z, Y, H and 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.

Sinusoidal Steady State Analysis: The sinusoidal forcing function, 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.

Network Functions: Network functions for single port and two port, Calculation of Network functions for Ladder and General Networks, Poles and Zeroes, Restriction of Poles and Zeroes for Driving point and Transfer functions, Time Domain Behavior from Pole Zero plot, Transfer Functions in terms of Y and Z functions, Scaling Network Functions.

Positive Real Functions: Positive real function and other properties, Herwitz polynomials, Computation of residues, even and odd functions, Test for Positive Real Functions.

Text Books:

1. Engineering Circuit Analysis, William H.Hayt Jr. and Jack E. Kemmerley, 5thEdition, McGraw Hill International Edition.
2. Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI.
3. Modern Network Synthesis, M. E. Van Valkenburg, Wiley Eastern.

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EC1106 WORKSHOP

Course Objectives: The objectives of this course are

- Get hands on experience with the working skills in Carpentry trade.
- Know how to work with Sheet Metal tools.
- Get familiar with the working skills of Metal Fitting operations.
- Get hands on experience with house hold electrical wiring.

Course Outcomes: At the completion of the course the student will be able to

- Can be able to work with Wood Materials in real time applications.
- Can be able to build various parts with Sheet Metal in day-to-day life.
- Can be able to apply Metal Fitting skills in various applications.
- Can be able to apply this knowledge to basic house electrical wiring and repairs.

SYLLABUS

I. **Carpentry:** Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.

II. **Sheet Metal:** Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.

III. **Fitting:** Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

IV. **House wiring:** Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

Reference Books:

1. Elements of workshop technology, Vol.1 by S. K. and H. K. Choudary.
2. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.

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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 μ_o and extraordinary μ_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.

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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, 43r^d 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.

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EC1202 CHEMISTRY

Course Objectives: The objectives of this course are

- 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 Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, bio-degradable polymers and fiber reinforced plastics
- To apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course Outcome: At the completion of the course the student will be able to

- Know the basic concepts and principles studied in Chemistry to Engineering.
- To provide an application of chemistry to different branches of engineering.
- To acquire knowledge in the areas of Water Chemistry, Polymers, Corrosion, Fuels and Lubricants and nanomaterials
- To suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Chemistry: 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.

Polymers and Plastics: Polymers: Definition – Types of Polymerization (Addition & Condensation) – Mechanisms of Addition Polymerization – Radical and Ionic – Thermodynamics of Polymerization Process. Plastics: Thermosetting and Thermoplastics – Effect of Polymer Structure on Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6, 6), Reinforced Plastics – Conducting Polymers.

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 Electro less Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Fuels and Lubricants: Solid Fuels: Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications; Liquid Fuels: Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number; Gaseous Fuels: Biogas, LPG and CNG – Characteristics – Applications; Rocket Fuels: Propellants – Classification – Characteristics
Lubricants: Classification – Mechanism – Properties of Lubricating Oils – Selection of Lubricants for Engineering Applications.

Nanomaterials: Nanomaterials, Properties and application of fullerenes, folderol, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites – Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

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.

Reference Books:

1. Engineering Chemistry – B. K. Sharma – Krishna Prakashan – Meerut.
2. Introduction to Nanoscience - S. M. Lindsay - Oxford University Press
3. Engineering Chemistry - B. L. Tembe, Kamaluddin and M. S. Krishnan, (NPTEL).

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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.

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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, YashwantKanetkar, 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.

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EC1205 SWITCHING THEORY AND 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. ECE:

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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.

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EC1207 CHEMISTRY LAB

Course Objectives: The objectives of this course are

- To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis.
- To prepare and use ion exchange/ zeolite columns for the removal of hardness of water
- To develop the skill of organic synthesis through the preparation of a polymer/ drug
- To Understand EDTA method

Course Outcomes: At the completion of the course the student will be able to

- Determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy.
- Develop novel materials to be used as zeolite and prepare columns for removal of hardness of water.
- Synthesize a polymer or a drug.
- To determine ZINC by EDTA method

SYLLABUS

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe(II)/Mohr's Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr's Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ion exchange/ Zeolite column for removal of hardness of water
10. Synthesis of Polymer/ drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.
2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria & Sons, New Delhi

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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.

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EC2101 MATHEMATICS-III

Course Objectives: The objectives of this course is to learn

- The basic knowledge and applications of Vector Calculus used in Engineering problems.
- About the gradient, divergence and curl under the differentiation of scalar and vector point functions, also on Line-, Surface- and Volume integrals under the integration of point functions along with their applications in Engineering issues.
- Transformation theorems such as green's theorem in the plane, Stake's theorem, Gauss Divergence theorem and their applications.
- How to formulate the Partial Differential Equations from the relation between the dependent and independent variables, the methods of solving first order first degree linear, non-linear Partial Differential Equations, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients.
- The procedure to find out the solutions of Partial Differential Equations by using the method of separation of variables (product method) about the formulation of one-dimensional wave (string equation), one-and two-dimensional Heat flow equations, Laplace's equation in Cartesian polar coordinates, and how to solve these equations using the method of separation of variables.
- The concept of integral transforms, namely, Fourier transforms, Fourier Sine, Cosine and related inverse transforms, and their applications in solving several Physical and Engineering problems.

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

- Operate the differential operator 'del' to the scalar and vector point functions, Calculate the Gradient, Divergence and Curl, Vector normal to a surface, maximum rate of change of a scalar field, test whether two surfaces are to cut orthogonally or not.
- Find the rate per unit volume at which the physical quantity is issuing from a point, the rate of inflow minus out flow using the Divergence and the angular velocity of rotation at any point of the vector field using the Curl.

- Test whether the given motion is irrotational or rotational, whether a vector force acting on a particle is conservative or not. find out the potential function from a given vector field.
- Obtain the well-known Laplace and poisson equations from an irrotational field. understand to determine the work done by a force field and circulation using a Line integral.
- Find out the Line, Surface and Volume integrals, find flux using surface integral and volumes using the volume integral. apply the vector integral theorems (Green's theorem in the plane, Stake's and Divergence theorems) for evaluating the double and triple integrals as these are used to find areas and volumes.
- Know the methods of solving Linear and Nonlinear first order and first degree partial differential equations.

SYLLABUS

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

Vector Integration: Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stake's theorem, volume integral, Gauss Divergence theorem. (All theorems without proofs). Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

Partial Differential Equations: Formation of partial differential equations, solutions of partial differential equations- equations solvable by direct integration, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order, Charpit's method. Homogeneous linear equations with constant coefficients- rules for finding the complementary function, rules for finding the particular integral (working procedure), non- homogeneous linear equations.

Applications Of Partial Differential Equations: Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat flow equation,

Two-dimensional heat flow in steady state - solution of Laplace's equation in Cartesian and polar coordinates (two dimensional).

Integral Transforms (Fourier Transform): Introduction, definition, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, Finite Fourier Sine and Cosine transforms, properties of Fourier transforms.

Convolution theorem for Fourier transforms, Parseval's identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.

Text Books:

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 publications
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. Mathematical Methods of Science & Engineering aided with MATLAB by Kanti B.Dutta, Cengage Learning India Pvt. Ltd.
5. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Company.
6. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.

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EC2102 ANALOG ELECTRONIC CIRCUITS

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 Weinbridge Oscillators.

Power Amplifiers: 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.

Tuned Voltage Amplifiers: Single Tuned and Stagger Tuned Amplifiers – Analysis – Double Tuned Amplifier – Bandwidth Calculation.

Text Books:

1. Integrated Electronics, Analog Digital Circuits and systems, Jacob Millman and D. Halkias, McGraw Hill, 1972
2. Electronic Devices and Circuits by Salivahanan, N.Suresh Kumar andA.Vallava Raj TMH, 2nd Edition, 1998.
3. Electronic Circuit Analysis, B.V.Rao, K.RajaRajeswari et.al, Pearson Publishers.

Reference Books:

1. Electronic Devices and Circuits, G.S.N. Raju, IK International Publications, New Delhi, 2006.
2. Electronic Devices and Circuits – G.K.Mithal, Khanna Publishers, 23rd Edition, 2004.

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EC2103 ELECTRICAL MACHINES

Course Objectives: The objectives of this course are

- To Study DC machines.
- To Study Transformers
- To introduce the concepts of ideal synchronous machines and poly-phase induction machines.
- To understand the applications which will be utilized in the electrical machines with its performance and theory of operation.

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

- Explain the theory of ideal synchronous machines and, basic machine relation.
- Analyze and apply the concept of steady state analysis and electrical transients in single phase and poly phase machines.
- Evaluate the basic operation and performance of special machines and can select special machines for different purpose.
- Explain the basic operation of single phase motors

SYLLABUS

Dc Machines: Constructional Features, Function of Commutator, Induced EMF and Torque Expressions, Relationship Between Terminal Voltage and Induced EMF for Generator and Motoring Action, Different Types of Excitation and Performance Characteristics of Different Types of DC Machines, Starting and Speed Control of DC Motors, Losses and Efficiency, Efficiency by Direct Loading, Swinburne's Test and Hopkin's Test, Applications of DC Machines.

Transformers: Constructional Details, EMF Equation, Equivalent Circuit, Voltage Regulation, Losses and Efficiency, Auto – Transformers, Instrument Transformers, Open/Short – Circuit Tests and Determination of Efficiency and Regulation.

Three – Phase Induction Machines: Construction, Rotating Magnetic Field and 3ph Induction Motor, Power Flow Diagram, Torque and Torque-slip Characteristics, Condition for Max. Torque and its Value, Starting and Speed Control, Losses and Efficiency, Equivalent Circuit and Circle Diagram of Induction Motor, No – Load and Rotor – Blocked Tests and Efficiency and Torque – Speed Characteristics.

Three – Phase Synchronous Machines: Generation of EMF, Constructional Details, Induced EMF, Synchronous Generator on No –Load and Load, Synchronous Impedance and Voltage Regulation. V – Curves and Inverted V – Curves, Synchronous Condenser, Starting of Synchronous Motors, Applications of Synchronous Machines.

Single – Phase Motors: Double Revolving Field Theory, Methods of Starting Single Phase Induction Motors, Universal Motor, Stepper Motor.

Text Books:

1. Electrical Machines, S. K. Bhattacharya, TMH Publications N. Delhi.
2. A First Course in Electrical Engineering, S. M. Tiwari, A. S. Binsaroor, Wheeler Publication.

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EC2104 SIGNALS & 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: Continuous –Time and Discrete –Time signals, Signal Energy and Power, Periodic Signals, Even and odd Signals, continuous-Time complex Exponential and Sinusoidal Signals, Discrete –Time complex Exponential and Sinusoidal Signals, Periodicity Properties of Discrete –Time Complex Exponentials, The Unit Impulse and Unit step Functions, The Discrete- Time Unit Step and Unit Impulse Functions, The Continuous-Time Unit impulse and Unit step Sequence, Continuous –Time and Discrete –Time

Systems, Interconnections of Systems, Basic System Properties, Discrete –Time LTI Systems: The Convolution Sum, The Representation of Continuous –Time Signals in terms of Impulses, The Commutative property, Casual LTI Systems Described by Differential and Difference Equations, Singularity Functions.

Fourier Series Representation of Periodic Signals: Introduction, Fourier Series Representation of continuous time Periodic Signals, convergence of the Fourier Series, Properties of continuous time Fourier Series, Fourier Series representation of discrete time periodic signals, Properties of discrete time Fourier Series.

Continuous and Discrete time Fourier Transform: Introduction, Representation of Aperiodic signals, the continuous time Fourier Transform, The Fourier Transform for periodic signals, Properties of the continuous time Fourier Transform, the convolution Property, Multiplication property, Systems characterized by linear constant-coefficient differential equations. Discrete time Fourier Transform, Representation of Aperiodic signals discrete time Fourier Transform, Fourier Transform for periodic signals, Properties of the Discrete time Fourier Transform, the convolution property, The multiplication property, Duality, Systems characterized by linear constant co-efficient differential equations.

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: Introduction, 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. The Transform, The Inverse Z-Transform, Geometrical evaluation of the Z-Transform from the Pole-Zero plot, Properties of Z-Transform, the initial theorems, some common Z-transform pairs, Analysis and characterization of LTI systems using the Z-Transforms, System function algebra and block diagram representation, The unilateral Z-Transform.

Text Books:

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

2. Signals Systems and Communication, B. P. Lathi, BS Publication

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 3rdEdn.

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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.

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EC2106 NETWORKS AND MACHINE LAB

Course Objectives: The objectives of this course are

- To Verify the ohm's law and Kirchhoff's law
- To Determine the efficiency and Regulation of Transformer by various tests
- To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
- To determine and predetermine the performance of DC machines.
- To demonstrate the characteristics of DC and AC motors

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

- Solve the Network problems using Network Theorems.
- Verify the ohm's law and Kirchhoff's law
- Evaluate the performance of DC Machines
- Determine the efficiency and Regulation of Transformer by various tests
- Demonstrate No-load/magnetization characteristics of DC and AC motors.

SYLLABUS

List of Experiments:

I. NETWORK LAB EXPERIMENTS

1. Verification of Superposition Theorem
2. Verification of Reciprocity Theorem
3. Verification of Thevenin's Theorem
4. Calibration of UPF Wattmeter
5. Verification of Ohm's law
6. Verification of Kirchhoff's law

II. ELECTRICAL MACHINES LAB EXPERIMENTS

7. No load and blocked rotor tests on 3-phase squirrel cage Induction motor

8. Regulation of alternator by synchronous Impedance method
9. Open circuit test and short circuit test on 1-phase transformer
10. Swim burner's test
11. No load and load characteristics of self-excited Shunt generator

EC2107 ANALOG ELECTRONICS AND CIRCUITS LAB WITH SIMULATION

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. Colpitts oscillator
3. RC-Phase shift oscillator
4. Two stage RC-Coupled Amplifier
5. Wein bridge oscillator
6. Hartley Oscillator
7. Class-B Push pull Amplifier
8. Voltage series feedback Amplifier

9. Common source FET Amplifier
10. Tuned Voltage Amplifier
11. Applications of Operational Amplifier
12. Frequency response of Op-amp

(Software Simulation)

13. Common emitter and common source Amplifier
14. Two stage RC coupled Amplifier
15. RC Phase shift oscillator using transistors
16. Class-A Power Amplifier (transformer less)
17. Class-B complementary symmetry Amplifier
18. High frequency common base (BJT) and common gate (JFET) Amplifier

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EC2108 DIGITAL ICS AND HDL 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 simulate logic gates and flip flops

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 in HDL
- Simulate and Analyze Flip-Flops, Shift Register and Counters using HDL

SYLLABUS

List of Experiments:

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. 4 - bit Shift-register

11. Seven segment display

SIMULATION EXPERIMENTS

1. Simulation of Logic gates

2. Simulation of Full adder

3. Simulation of Multiplexer & De-Multiplexer

4. Simulation of Decoder & Encoder

5. Simulation of Flip flops (SR & D)

6. Simulation of Up-down counter& Shift register

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EC2109 PROGRAMMING SKILLS FOR PROBLEM SOLVING

Course Objectives: The objectives of this course are

- To Impart the Knowledge to the students with MATLAB software. [This enhances programming knowledge in Research and Development].
- To provide a working introduction to the MATLAB technical computing environment. [Themes of data analysis, visualization, and programming].
- To introduce students the use of a high-level programming language, MATLAB. [scientific problem solving with applications and examples from Engineering.
- To Improve Programming skills for solving real time problems

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

- Understand the basics of MATLAB
- Break a complex task up into smaller, simpler tasks
- Tabulate results and analyze.
- To analyze the basic image processing

Introduction to Programming Basics: The MATLAB desktop, the command window, the command history window, the MATLAB workspace, getting help, special symbols. Matrices and Vectors: Input, Indexing (or subscripting), Matrix manipulation, Creating vectors. Matrix and Array Operations: Arithmetic operations, Relational operations, Logical operations, Elementary math functions, Matrix functions, A Special Note on Array Operations.

Introduction to plotting: Using simple x, y plots, printing a plot, exporting a plot as a graphical image, multiple plots, line color, line style, marker style, grid and legend.

Script files and functions. Command- Line Functions: Inline functions, Anonymous functions, Finding the determinant of a matrix, finding eigenvalues and eigenvectors, solving a linear system, roots of a polynomial, matrix factorizations, Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit impulse, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc, exponential. generation of random numbers.

Text Books:

1. A Guide to MATLAB for beginners and Experienced users by Brian R. Hunt, Ronald R Lipsman.
2. Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers by Rudra pratap.

List of Programs:

1. Write a program to implement basic operations on multidimensional arrays and vectors.
2. Write a program to perform different operations and manipulations on Matrices.
3. Write a program to generate various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
4. Write a program to perform operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
5. Write a program to plot the voltage across capacitor during charging ($v_C = v_0\left[1 - e^{-t/RC}\right]$)
6. Write a program for solving the linear system of equations.
7. Write a program to integrate and differentiate sinusoidal signals and plot the results with different colours.
8. Write a program to compute mean, median, standard deviation and variance of a set of data using formulae and verify using built-in functions.
9. Write a program to compare the results of the built-in and user-defined function to compute cos(x) and sin(x) series.

10. Write a program to find the Even & Odd and Real & Imaginary parts of a Signal/Sequence.
11. Write a program to find trigonometric and exponential Fourier series coefficients of a rectangular periodic signal.
12. Write a program to find the Fourier transform of a given signal and plot its amplitude and phase spectrum.
13. Write a program to verify the Linearity and Time Invariance Properties of a given Continuous/Discrete System.
14. Write a program to read, display an image and calculate its RGB components.
15. Write a program to convert colour image to grey scale and plot its histogram.
16. Write a program to generate a vector of 100 uniformly and normal distributed random numbers. Plot a histogram of the distribution. Do the same for 1000 and 10,000 uniformly distributed random numbers.
17. Write a program to Factorize the given matrices using different factorizations (LU, QR, CHOLESKY, SVD).

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EC2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

(Common for all Branches)

Course Objectives: The objectives of this course are

- Development of a holistic perspective based on self-exploration about themselves (Human being), family, society and nature/existence.
- This course will illuminate the students in the concepts of laws and its applicability to Engineers.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection, Development of commitment and courage to act and also enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and professional lives
- To enable the students to imbibe the Values and Ethical Behavior in the personal and Professional lives
- The students will learn the rights and responsibilities Individual, employee, team member and a global citizen

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

- Grasp the meaning of the concept – Law and also Get an overview of the laws relating to Engineers and also Apprehend the importance of being a law-abiding person and They would have better critical ability
- Self-explore by using different techniques to live in harmony at various levels

- Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life
- Students are expected to become more aware of themselves and their surroundings (family, society, nature)
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society

SYLLABUS

Need, Basic Guidelines, Content and Process for Value Education: Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation - as the process for self-exploration, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking, Include practice sessions and case studies.

Understanding Harmony in the Human Being - Harmony in Myself: Understanding human being as: a co-existence of the sentient 'I' and the material 'Body', the needs of Self ('I') and 'Body' - happiness and physical facility, the Body as an instrument of 'I' (I being the doer, seer and enjoyer), the characteristics and activities of 'I' and harmony in 'I', the harmony of I with the Body: San yam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, P to ensure Sanyam and Health, Include practice sessions and case studies.

Understanding Harmony in the Family and Society - Harmony in Human – Human Relationship: Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness;

Trust and Respect as the foundational values of relationship, the meaning of Trust; Difference between intention and competence, the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, the harmony in the society (society being an extension of family), Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order from family to world family, Include practice sessions and case studies.

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all – pervasive space, Holistic perception of harmony at all levels of existence, Include practice sessions and case studies.

Concept of Law and Law of Torts: Understanding Essentials of a Valid Contract and the basics of contract law protecting rights and obligations, Introduction to the Law of Torts and the basics to protect oneself and the company Law affecting the Workplace Employers Responsibilities/Duties Hiring Practices, Introduction to Intellectual Property Law, Professional Code of Conduct for Engineers, Relationship between Law and Ethics, Include practice sessions and case studies.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Include practice sessions and case studies.

Text Books:

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

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

3. R. Subramanian, "Professional Ethics", Oxford University Press.

4. S.B. Srivasthva, "Professional Ethics & Human Values", SciTech Publications (India) Pvt. Ltd. New Delhi.

5. D.R. Kiran, "Professional Ethics & Human Values", TATA Mc Graw Hill Education.

6. Saroj Kumar, "Business Law" and Avtar Singh, "Law of Contract".

Reference Books:

1. Jeevan Vidya: EEK Pari Chaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.

2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book), Mohandas Karamchand Gandhi "The Story of My Experiments with Truth", E. FSchumacher. "Small is Beautiful", Slow is Beautiful –Cecile Andrews, J C Kuma Rappa "Economy of Permanence", Pandit Sunder Lal "Bharat Mein Angreji Raj" and Dharampal, "Rediscovering India.

4. G K Kapoor, "Business Law" and Sen & Mitra, "Business & Commercial Laws" and Calvin Frank Allen, "Business law for Engineers".

5. Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). *Introduction to Psychology*. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

6. Govindarajan, M; Natarajan, G. M. & Senthil Kumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi.

7. Go gate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.

8. Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, "Engineering Ethics, Concepts Cases: 4e, Cengage learning, 2015.

9. Caroline Whitbec, "Ethics in Engineering Practice & Research: 2e, Cambridge University Press 2015.

EC2201 MATHEMATICS-IV

Course Objectives: The objectives of this course are

- To introduce the concepts of Cauchy-Reimann Equations, Harmonic functions
- To understand residue theorem
- To learn the difference equations to discrete systems.
- To learn the properties of Z- transforms and its applications.

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

- Analyze limit, continuity and differentiation of functions of complex variables and Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions.
- Understand Cauchy theorem and Cauchy integral formulas and apply these to evaluate complex contour integrals and represent functions as Taylor and Laurent series and determine their intervals of convergence and use residue theorem to evaluate certain real definite integrals.
- Discuss and demonstrate difference equations to discrete systems.
- Understand the characteristics and properties of Z- transforms and its applications
- Analyze the statistical data by using statistical tests and to draw valid inferences about the population parameters.

SYLLABUS

Functions of Complex Variables: Introduction-Limit and continuity of f(z)- Derivative of f(z), Cauchy-Reimann Equations, Analytic Functions, Harmonic functions, Orthogonal systems, Applications to flow problems, Geometrical representation of f(z).

Integration of complex functions, Cauchy's theorem, Cauchy's integral formula and their applications.

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 of analytic functions.

Residues and Calculations of residues, Cauchy's Residue Theorem, Evaluation of real definite integrals: Integration around unit circle, semi-circle.

Difference Equations & Z-transforms: Introduction - Formation of difference equations - Linear difference equations - Rules for finding complementary function - Rules for finding particular integral - simultaneous difference equations with constant coefficients - Applications to deflection of a loaded string.

Introduction to Z-Transforms - Some standard Z-transforms - Linear Property - Damping Rule - Shifting U_n to the right and to the left-multiplication by n-Two basic theorems - Some useful Z-transforms - Inverse Z-transformation - Convolution theorem - Convergence of Z-transform - Two-sided Z-transform - Evaluation of inverse Z-transform - Application to Difference equations.

Correlation, Regression and Distributions: Introduction - correlation - coefficient of correlation -Lines of regression.

Introduction to Discrete and Continuous Random Variables - Distributions: binomial distribution, Poisson distribution, exponential distribution, normal distribution.

Sampling Theory: Introduction - Testing of hypothesis - Level of significance - Confidence limits - Test of significance of large samples - comparison of large samples- Test of significance for means of two large samples.

Student t-distribution - Significance test of sample means - Significance test of difference between sample means - Chisquare test - Goodness of fit - F-distribution.

Text Book:

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

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti, I.K. International publications
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. Engineering Mathematics series by Chandrica Prasad.

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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, λ/8, λ/4, λ/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 MICROCONTROLLERS

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, 8051Microcontrollers, 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.

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EC2204 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 averages of these random variables using probability density and distribution functions 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.

EC2205 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.

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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.

8086 INTERFACING

15. Write a program to interface stepper motor.

16. Write a program to interface keyboard with 8279 display controllers.

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EC2207 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.

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EC2208 PYTHON PROGRAMMING

Course Objectives: The objectives of this course are

- To learn about Python programming language syntax, semantics, and the runtime environment.
- To be familiarized with universal computer programming concepts like data types, containers.
- To be familiarized with general computer programming concepts like conditional execution, loops & functions.
- To be familiarized with general coding techniques and object-oriented programming.

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

- Develop essential programming skills in computer programming concepts like data types, Containers.
- Apply the basics of programming in the Python language.
- Solve coding tasks related conditional execution, loops.

- Solve coding tasks related to the fundamental notions and techniques used in object-oriented programming.

SYLLABUS

Introduction: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output.

Data Types, and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops.

Control Statement: Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration the While Loop.

Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files.

List and Dictionaries: Lists, Defining Simple Functions, Dictionaries Design with Function: Functions as Abstraction Mechanisms, Problem Solving with Top-Down Design, Design with Recursive Functions.

Modules: Modules, Standard Modules, Packages.

File Operations: Reading config files in python, writing log files in python, Understanding read functions, read (), read line () and read lines (), Understanding writes functions, write () and writelines (), Manipulating file pointer using seek, Programming using file operations

Text Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.

2. Python Programming: A Modern Approach, Vamsi Karama, Pearson.

Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.

2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

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EC2209 ENVIRONMENTAL SCIENCE

(Common for all Branches)

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, conversion processes, Wind Energy, energy conversion technologies, their principles, 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 industrial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste processing 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 Undergraduate 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 engineering and science. Englewood Cliffs, NJ: Prentice Hall.
4. Enger, E. and Smith, B., Environmental Science: A Study of Interrelationships, 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, 2016 and its amendments 2018.
6. MoEF&CC, Govt. of India, CPCB: Plastic waste management rules, 2016.

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EC3101 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. Op-Amps and Linear ICs- Ramakanth Gayakwad, PHI, 1987.
2. Linear Integrated Circuits- D. Roy Chowdhury, New Age International(p) Ltd,2nd Edition ,2003.

Reference Books:

1. Integrated Circuits- Botkar, Khanna Publications.

2. Applications of Linear ICs- Clayton.
3. Microelectronics-Jacob Millman.

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EC3102 DIGITAL COMMUNICATIONS

Course Objectives: The objectives of this course are

- To understand different pulse digital modulation techniques and their comparison.
- To familiarize various digital modulation techniques and calculation of their error probabilities.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

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

- Differentiate the various types of pulse digital modulation techniques.
- Outline the band pass digital modulation and demodulation techniques.
- Evaluate the performance of digital communication system in the presence of noise.

- Analyze various receivers and determine the probability of error for various digital modulation techniques.
- Perform the time and frequency domain analysis of the signals in a digital communication system
- Classify the different spread spectrum modulation techniques.

SYLLABUS

Analog-to-Digital Conversion: Pulse modulation techniques, Sampling, Time Division Multiplexing, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Digital Modulation Techniques: Pulse Code Modulation, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation, Continuously Variable Slope Delta Modulation, Companding, Noise in Pulse-Code and Delta-Modulation Systems.

Binary Phase-Shift Keying, Differential Phase-Shift Keying, Differentially-Encoded PSK (DEPSK), Quadrature Phase-Shift Keying (QPSK), M-ary PSK, Quadrature Amplitude Shift Keying (QASK), Binary Frequency Shift-Keying, Similarity of BFSK and BPSK, M-ary FSK, Minimum Shift Keying (MSK), Duo-binary Encoding.

Mathematical Representation of Noise: Some Sources of Noise, Frequency-Domain Representation of Noise, The Effect of Filtering on the Probability Density of Gaussian Noise, Spectral Components of Noise Response of a Narrowband Filter to Noise, Effect of a Filter on the Power Spectral Density of Noise, Superposition of Noises, Mixing Involving Noise, Linear Filtering, Noise Bandwidth, Quadrature Components of Noise, Power Spectral Density of n(t) and n(t), Probability Density of n(t), n(t), and their Time Derivatives, Representation of Noise Using Orthonormal Coordinates, Irrelevant Noise Components

Data Transmission: A Base-band Signal Receiver, Probability of Error, The Optimum Filter, White Noise: The Matched Filter, Probability of Error of the Matched Filter, Coherent Reception: Correlation, Phase-Shift Keying, Frequency-Shift Keying, Non-coherent Detection of FSK, Differential PSK, Four Phase PSK (QPSK), Error Probability for QPSK, Probability of Error of Minimum Shift Keying (MSK), Comparison of Modulation Systems.

Spread Spectrum Modulation: Direct Sequence (DS) Spread Spectrum, Use of Spread Spectrum with Code Division, Multiple Access (CDMA), Ranging using DS Spread

Spectrum, Frequency Hopping (FH) Spread Spectrum, Generation and Characteristics of PN Sequences, Acquisition (Coarse Synchronization) of a FH Signal, Tracking (Fine Synchronization) of a FH Signal, Acquisition (Coarse Synchronization) of a DS Signal, Tracking of a DS Signal.

Text Books:

1. Analog and Digital Communication Systems by Martin S. Roden, 3rd edition, Prentice Hall, 1994;
2. Principles of Communications by Taub and Schilling.

Reference Books:

1. Modern Analog and Digital Communications by B.P.Lathi, Oxford reprint, 3rd Edition, 2004
2. Digital and Analog Communication systems by Samshanmugam, John Wiley, 2005.
3. Principles of Digital Communications- J.Das, SK.Mullick, P.K.Chatterjee.

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EC3103 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.

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EC3104 Professional Elective-I

(Refer Annexure-I for Syllabus details)

EC3105 Open Elective-I

(Refer Annexure-II for Syllabus details)

EC3106 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.

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EC3107 DIGITAL COMMUNICATIONS LAB

Course Objectives: The objectives of this course are

- A/D and D/A Converters.
- Continuously Variable Slope Delta Modulation
- Phase Shift Keying (PSK) Modulator
- Frequency Shift Keying (PSK) Modulator.
- Encoder and Decoder

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

- A/D and D/A Converters.
- Continuously Variable Slope Delta Modulation
- Phase Shift Keying (PSK) Modulator
- Frequency Shift Keying (PSK) Modulator.
- Understand encoding and decoding techniques for digital communication systems

SYLLABUS

List of Experiments:

1. Sample the given input signal for different sampling rates and recover the signal by means of appropriate low – pass filter.
2. Study the Pulse – Width Modulation for both AC and DC Modulating Signals and obtain the corresponding waveforms.
3. Study the Pulse – Position Modulation for both AC and DC Modulating Signals and obtain the corresponding waveforms.

4. Study the functioning of a given Analog to Digital Converter.

5. Study the functioning of a given Digital to Analog Converter.

6. Encode the given 4-Bit Data Word into 16-Bit Orthogonal Encoded Word using Hadamard Code.

7. Decode the 16-Bit Orthogonal Encoded Word to 4-Bit Data Word.

8. Study the performance of the given Continuously Variable Slope Delta Modulation (CVSD).

9. Obtain the characteristics of the Phase Shift Keying (PSK) Modulator.

10. Obtain the characteristics of the Frequency Shift Keying (FSK) Modulator.

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EC3108 OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Course Objectives: The objectives of this course are

- To write programs using abstract classes.
- To write programs for solving real world problems using java collection frame work.
- To write multithreaded programs.
- To write GUI programs using swing controls in Java.
- To introduce java compiler and eclipse platform.
- To impart hands on experience with java programming.

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

- Able to write programs for solving real world problems using java collection framework.
- Able to write programs using abstract classes.
- Able to write multithreaded programs.
- Able to write GUI programs using swing controls in Java.

SYLLABUS

List of Programs:

1. Use Eclipse or Net bean platform and acquaint with the various menus. Create a test project, add a test class, and run it. See how you can use auto suggestions, auto fill. Try code formatterand code refactoring like renaming variables, methods, and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and afor loop.
2. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divided by zero.
3. a) Develop an applet in Java that displays a simple message.
   b) Develop an applet in Java that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named

"Compute" is clicked.

4. Write a Java program that creates a user interface to perform integer divisions. The user enterstwo numbers in the text fields, Num1 and Num2. The division of Num1 and Num 2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the exception in a message dialog box.
5. Write a Java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print thevalue of cube of the number.
6. Write a Java program for the following:
    i) Create a doubly linked list of elements.
    ii) Delete a given element from the above list.
    iii) Display the contents of the list after deletion.
7. Write a Java program that simulates a traffic light. The program lets the user select one of threelights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with "Stop" or "Ready" or "Go" should appear above the buttons in selected color. Initially, thereis no message shown.
8. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
9. Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are separated by commas. Write a java program to display the table using Labels in Grid Layout.
10. Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired (Use Adapter classes).

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EC3201 ANTENNAS AND WAVE PROPAGATION

Course Objectives: The objectives of this course are

- To understand the applications of the electromagnetic waves in free space.
- To introduce the working principles of various types of antennas.
- To discuss the major applications of antennas with an emphasis on how antennas are employed to meet electronic system requirements.
- To understand the concepts of radio wave propagation in the atmosphere.

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

- Understand the radiation mechanism of an antenna.
- Identify basic antenna parameters.
- Design and Analyze various types of antenna Arrays.
- Construct and Analyze HF, VHF and UHF Antennas.
- Analyze Microwave antennas and summarize the antenna measurement techniques.
- Outline the characteristics of radio wave propagation.

SYLLABUS

Radiation and Antennas: Antenna definition and Functions, Network theorems, Properties of antennas, Antenna parameters, Polarization, Basic antenna elements, Radiation mechanism, Radiation fields of alternating current element, Radiated power and radiation resistance of current element, Radiation, induction and electrostatic fields, Hertzian dipole, Different current distributions in linear antennas, Radiation from half-wave dipole, Radiation from quarter wave monopole, Radiation characteristics of dipoles.

Analysis of Linear Arrays: Directional characteristics of dipole antennas, Radiation pattern of alternating current element, Radiation pattern expressions of centre-fed vertical dipoles of finite

length, Radiation patterns of centre-fed vertical dipoles, Radiation patterns of centre-fed horizontal dipoles, Radiation patterns of vertical dipoles, Two-element uniform array, Uniform linear arrays, Field strength of a uniform linear array, First sidelobe ratio (SLR), Broadside and End-fire arrays, Patterns of array of non-isotropic radiators, Multiplication of patterns, Generalized expression for principle of pattern multiplication, Radiation pattern characteristics, Binomial arrays, Effect of earth on vertical patterns, Effect of earth on radiation resistance, Methods of excitation, Impedance matching techniques, Transmission loss between transmitting and receiving antennas - FRIIS formula, Antenna temperature and signal-to-noise ratio.

Array Synthesis: Introduction, Synthesis methods, Fourier transform method, Linear array design by Woodward-Lawson method, Dolph-chebychev method (Tschebyscheff distribution), Taylor method, Laplace transform method, Standard amplitude distributions.

HF, VHF and UHF Antennas: Introduction, Isotropic radiators, Directional antennas, Omni-directional antennas, Resonant antennas, Nonresonant antennas, LF antennas, Antennas for HF, VHF and UHF, Dipole arrays, Folded dipole, V-Antennas, Inverted V-antennas, Rhombic antenna, Yagi-Uda antenna, Log-periodic antennas, Loop antenna, Helical antenna, Whip antenna, Ferrite rod antenna, Turnstile antennas, Discone antennas, Notch antenna.

Microwave Antennas and Antenna Measurements: Introduction, Rod reflector, Plane reflector, Corner reflector, Parabolic reflector, Types of parabolic reflectors, Feed systems for parabolic reflectors, Shaped beam antennas, Horn antennas, Corrugated horns, Slot antennas, Impedance of a few typical dipoles, Slots in the walls of rectangular waveguides, Babinet's principle, Lens antennas, Microstrip antennas , Measurement ranges, Indoor and outdoor ranges, Antenna impedance measurements, Measurement of radiation resistance, Gain measurements, Measurement of antenna bandwidth, Directivity measurement, Measurement of sidelobe ratio, Measurement of radiation efficiency, Measurement of antenna aperture efficiency, Measurement of polarization of antenna, Phase measurement.

Wave Propagation: Propagation characteristics of EM Waves, Factors involved in the propagation of radio waves, Ground wave propagation, Ground wave field strength by Maxwell's equations, Reflection of radio waves by the surface of the earth, Roughness of earth, Reflection factors of earth, Wave tilt of the ground wave, Tropospheric wave propagation,

Atmospheric effects in space wave propagation, Duct propagation, Radio horizon, Troposcatter, Fading of EM waves in Troposphere, Line of sight (LOS), Ionospheric propagation, Characteristics of ionosphere, Refractive index of ionosphere, Phase and group velocities, Mechanism of Ionospheric propagation, reflection and refraction, Characteristic parameters of Ionospheric propagation, Sky wave field strength, Fading and diversity techniques, Faraday's rotation, Effect of earth's magnetic field.

Text Book:

1. Antennas and Wave Propagation, G.S.N. Raju, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2007.

Reference Books:

1. EM Waves and Radiation Systems, E. C. Jordan and K. G. Balmain, PHI – N. Delhi, 1997.
2. Antennas, J.D. Kraus, McGraw Hill, NY.
3. Antenna theory, C.A. Balanis, John Wiley & Sons, NY, 1982.

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EC3202 DIGITAL SIGNAL PROCESSING

Course Objectives: The objectives of this course are

- To Analyze the Discrete Time Signals and Systems.
- To Understand the various implementations of digital filter structures.
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform.
- To learn the FIR and IIR Filter design procedures.
- To know the applications of DSP.

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

- Apply the concepts of difference equations to Analyze the discrete time systems
- Realize the Digital filters along with its structures and finite word length effects.
- Make use of the FFT algorithm for solving the DFT of a given signal.
- Analyze the Digital IIR & FIR filter design for different specifications.
- Analyze the Digital FIR filter design for different specifications.
- Understand the signal Processing concepts in various applications.

SYLLABUS

Discrete - Time Signals and Systems: Discrete - Time Signals – Sequences, Linear Shift – Invariant Systems, Stability and Causality, Linear Constants – Coefficient Difference Equations, Frequency Domain Representation of Discrete – Time Signals and Systems.

Applications of Z – Transforms: System Functions H(z) of Digital Systems, Stability Analysis, Structure and Realization of Digital Filters, Finite Word Length Effects.

Discrete Fourier Transform (DFT): Properties of the DFS, DFS Representation of Periodic Sequences, Properties of DFT, Convolution of Sequences.

Fast – Fourier Transforms (FFT): Radix – 2 Decimation – In – Time (DIT) and Decimation – In – Frequency (DIF), FFT Algorithms, Inverse FFT.

IIR Digital Filter Design Techniques: Design of IIR Filters from Analog Filters, Analog Filters Approximations (Butterworth and Chebyshev Approximations), Frequency Transformations, General Considerations in Digital Filter Design, Bilinear Transformation Method, Step and Impulse Invariance Technique.

Design of FIR Filters: Fourier series Method, Window Function Techniques, Comparison of IIR and FIR Filters.

Applications: Applications of FFT in Spectrum Analysis and Filtering, Application of DSP in Speech Processing.

Text Book:

1. Alan V. Oppenheim and Ronald W. Schafer: Digital Signal Processing, PHI.

Reference Books:

1. Sanjit K. Mitra, Digital Signal Processing "A – Computer Based Approach", Tata Mc Graw Hill.
2. Raddar and Rabiner, Application of Digital Signal Processing.
3. S. P. Eugene Xavier, Signals, Systems and Signal Processing, S. Chand and Co. Ltd.
4. Antonio, Analysis and Design of Digital Filters, Tata Mc Graw Hill.

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EC3203 MICROWAVE ENGINEERING

Course Objectives: The objectives of this course are

- To understand about the microwave components
- To understand Microwave signal generators and amplifiers
- To analyze Various microwave circuits and microwave integrated circuits.
- To analyze Various microwave parameter measurements

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

- Analyze the microwave components.
- Illustrate microwave signal generators and amplifiers.
- Infer various microwave circuits and microwave integrated circuits.
- Infer various microwave parameter measurements.

SYLLABUS

Microwave Components: Introduction to Microwaves and their applications, Coaxial Line Components, Wave-guide Components, Directional Couplers, Hybrid Tee Junction, Magic Tee, Attenuators, Ferrite Devices, Isolators, Circulators, Cavity Resonators, Re-entrant Cavities, Wave-meters, Microwave Filters, Detectors, Mixers.

Microwave Signal Generators and Amplifiers: Vacuum Tube Triodes, Resonant Cavity Devices, Reflex Klystron, two – Cavity Klystron, Multi – Cavity Klystron, Slow – Wave Devices, TWT, Crossed Field Devices, Magnetrons, Semiconductor Devices, Microwave BJTs, FETs, Tunnel Diodes, Gunn Diode, IMPATT, TRAPATT Diodes.

Microwave Circuits: Scattering Matrix and its Properties, Scattering Matrix of directional coupler, circulator, E Plane Tee, H plane Tee and Magic Tee.

Microwave Integrated Circuits: Materials, Substrate, Conductor, Dielectric and Resistive Materials, MMIC Growth, Fabrication Techniques, MOSFET Fabrication, NMOS Growth and CMOS Development, Thin Film Formation.

Microwave Measurements: VSWR, Frequency, Guide Wavelength, Coupling and Directivity measurements.

Text Books:

1. Microwave Engineering, G.S.N. Raju, IK International Publishers,
2. Microwave Communications – Components and Circuits, E. Hund, McGraw Hill.
3. Microwave Devices and Circuits, S. Y. Liao, PHI.
4. Microwave Engineering, R. Chatterjee, East – West Press Pvt. Ltd.

Reference Books:

1. Foundations For Microwave Engineering, R. R. Collin, McGraw Hill.

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EC3204 Professional Elective-II
(Refer Annexure-I for Syllabus details)

EC3205 Open Elective-II
(Refer Annexure-II for Syllabus details)

EC3206 ANTENNA SIMULATION LABORATORY

Course Objectives: The objectives of this course are

- To understand the fundamental working principle of an antenna.
- To describe/explore the different antenna parameters like input impedance, far-field radiation patterns, reflection coefficient, etc.
- To apply the different feeding technique.
- To evaluate and perform the optimization to achieve a certain goal.
- To design the wire antennas, microstrip antennas, etc.

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

- Understand the working principle of different antennas
- Design wire antennas and microstrip antennas using HFSS.
- Understand the different feeding technique
- Design wire antennas, Microstrip antennas, and Microstrip based filters using EM simulator.

SYLLABUS

List of Experiments:

1. Design of fundamental parameters of the antenna and an overview of HFSS to measure different antenna parameters.
2. Design of a half-wave dipole antenna.
3. Design of a quarter-wave monopole antenna.
4. Design and simulation of rectangular microstrip patch antenna with a particular operating frequency, dielectric constant and substrate thickness.
5. Design of microstrip patch antenna using a coaxial feeding technique.
6. Design and simulation of dual-band rectangular patch antenna using the inset feeding technique.
7. Design and simulation of rectangular microstrip patch antenna using CPW feeding with slot for bandwidth enhancement.
8. Design of aperture coupled rectangular microstrip patch antenna with two different substrates.

9. Design of proximity coupled rectangular microstrip patch antenna.
10. Design and simulation of Dielectric Resonator Antenna with a particular operating frequency, dielectric constant and substrate thickness.
11. Design and Simulation of MPA using MATLAB.
12. Design and Simulation of MPA using the CST Microwave Studio Suite 2020.

*****

EC3207 DIGITAL SIGNAL PROCESSING LAB

Course Objectives: The objectives of this course are

- To make familiar with practical implementation of the digital signal processing.
- To develop DSP algorithms for convolution, correlation and DFT.
- To design digital filters.
- To have hands on experience in MATLAB and DSP processor.

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

- Generation and Implementation of discrete time signals and systems using MATLAB
- Analyze the Frequency analysis of discrete signals and systems using MATLAB.
- Design and simulate FIR and IIR filters with different techniques using MATLAB.
- Verification of Linear and Circular Convolution using DSP Processor.
- Implementation of FIR and IIR filters with different techniques using DSP Processor.

SYLLABUS

List of Experiments:

MATLAB Experiments:

1. Generation of discrete –time sequences
2. Implementation of Discrete time systems
   a) Linear Convolution of two sequences
   b) Circular Convolution of two sequences
3. Frequency analysis of discrete time sequences
4. Frequency analysis of discrete time systems
5. Design of IIR digital filter a) Butterworth b) Chebyshev
6. Design of FIR digital filter a) Hamming window b) rectangular window

Hardware Experiments:

1. Verification of Linear Convolution using DSP Processor kit
2. Verification of Circular Convolution using DSP Processor kit
3. Implementation of IIR Filters on DSP Processor
4. Implementation of FIR Filters using Window Techniques on DSP Processor

EC3208 MICROWAVE ENGINEERING LAB

Course Objectives: The objectives of this course are to determine

- VSWR
- V-I Characteristics of GUNN Diode
- Coupling Factor and Directivity of a 4-Port directional coupler.
- Microwave frequency

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

- VSWR
- V-I Characteristics of GUNN Diode
- Coupling Factor and Directivity of a 4-Port directional coupler
- Microwave frequency

SYLLABUS

List of Experiments:

1. Measurement of VSWR
2. V-I Characteristics of GUNN Diode
3. Measurement of Coupling Factor and Directivity of a 4-Port directional coupler
4. Measurement of Microwave frequency
5. Reflex Klystron Characteristics
6. Radiation Pattern of Horn Antenna
7. Fiber Optic Analog Link
8. Fiber Optic Digital Link
9. Other four experiments from the choice either from Microwave Engineering or from Antenna Theory.

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EC3209 SOFT SKILLS

Course Objectives: The objectives of this course are

- To develop skills to communicate clearly.
- To aid students in building interpersonal skills.
- To enhance team building and time management skills.
- To inculcate active listening and responding skills.

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

- Make use of techniques for self-awareness and self-development.
- Apply the conceptual understanding of communication into everyday practice.
- Understand the importance of teamwork and group discussions skills.
- Develop time management and stress management.

SYLLABUS

Introduction to Soft Skills: Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behaviour, Analysing Performance.

Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, Close-Ask Q), Telephone Interviews, Types of Questions.

Reference Books:

1. Krannich, Caryl, and Krannich, Ronald L. Nail the Resume! Great Tips for Creating Dynamite Resumes. United States, Impact Publications, 2005.
2. Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012
3. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Education, 2001.
4. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.
5. Rizvi, Ashraf M. Effective Technical Communication: India, McGraw-Hill Education. 2010
6. Thorpe, Edgar &Showick Thorpe. Winning at Interviews. 2nd Edition. Delhi: Dorling Kindersley, 2006.

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EC4101 Professional Elective-III
(Note: Refer Annexure-I for Syllabus details)

EC4102 Professional Elective-IV
(Note: Refer Annexure-I for Syllabus details)

EC4103 Professional Elective-V
(Note: Refer Annexure-I for Syllabus details)

EC4104 Open Elective-III
(Note: Refer Annexure-II for Syllabus details)

EC4105 Open Elective-IV
(Note: Refer Annexure-II for Syllabus details)

EC4106 HSS-Elective
(Note: Refer Annexure-III for Syllabus details)

EC4107 INTERNET OF THINGS LAB

Course Objectives: The objectives of this course are

- Interface Arduino to ZigBee module
- Interface Arduino to GSM module
- Interface sensors to Raspberry Pi module.
- Design an IoT system

Course Outcomes:

- Interface Arduino to ZigBee module and GSM modules
- Interface Arduino Bluetooth modules
- Make use of Cloud platform to upload and analyse any sensor data
- Use of Devices, Gateways and Data Management in IoT.
- Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

SYLLABUS

List of Experiments:

1. Introduction to Arduino platform and programming CO1
2. Interfacing Arduino to Zigbee module CO1, CO3
3. Interfacing Arduino to GSM module CO1, CO3
4. Interfacing Arduino to Bluetooth Module CO1, CO3
5. Introduction to Raspberry PI platform and python programming CO2
6. Interfacing sensors to Raspberry PI CO2
7. Communicate between Arduino and Raspberry PI using any wireless medium CO1, CO2, CO3
8. Setup a cloud platform to log the data CO4
9. Log Data using Raspberry PI and upload to the cloud platform CO5
10. Design an IOT based system CO6/

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ANNEXURE-I

PROFESSIONAL ELECTIVES

1. Global Positioning System
2. Radar Engineering
3. Cellular Mobile Communication
4. Electronic Measurements and Instrumentation
5. Micro Electronics
6. EMI/EMC
7. Internet and Web Technology
8. Information Theory and Coding
9. Smart Antenna Systems
10. TV and Satellite Communication System
11. Transducers and Signal Conditioning
12. Low Power VLSI Design
13. Digital Image Processing
14. Fiber Optic Communication
15. Advanced Microprocessors

GLOBAL POSITIONING SYSTEM

Course Objectives: To provide an insight into the basic concepts of

- Global Position System with GPS working principle.
- other global satellite constellations.
- GPS satellite constellation and signals.
- block diagrams of Synthetic Aperture Radar (SAR), Phased array Radars and others.
- different coordinate systems

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

- Understand the basic concepts of Global Position System with GPS working principle
- Understand the basic concepts of other global satellite constellations
- Analyze GPS satellite constellation and signals
- Examine using different coordinate systems

SYLLABUS

Introduction to GPS: Global Position System, the History of GPS, the Evolution of GPS, Development of NAVSTAR GPS, Block I,Block II satellites, Block IIA, Block IIR and Block II R-M satellites.

GPS Working: Principal Trilateration, Determination of where the satellites are, Determination of how far the satellites are, Determining the receiver position in 2D or X-Y Plane, Determining the receiver position in 3D or X-Y-Z Plane, basic equations for finding user position, user position determination with least squares estimator.

Other Global Satellite Constellation: GLONASS, GALILEO, Comparison of 3GNSS (GPS, GALILEO, GLONASS) in terms of constellation and services provided.

GPS Satellite constellation and Signal Structure: GPS system segments, Space segment, Control segment, User segment, GPS Signals, Pseudorandom noise (PRN) code, C/A code , P code Navigation data, Signal structure of GPS.

Coordinate Systems: Geoid, Ellipsoid, Coordinate Systems, Geodetic and Geo centric coordinate systems, ECEF coordinates, world geodetic 1984 system, Conversion between Cartesian and geodetic coordinate frame.

Text Books:

1. G S RAO, Global Navigation Satellite Systems, McGraw-Hill Publications, New Delhi, 2010
2. Pratap Mishra, Global positioning system: signals, measurements, and performance, Ganga-Jamuna Press, 2006

Reference Books:

1. Scott Gleason and Demoz Gebre-Egziabher, GNSS Applications and Methods, Artech House, 685 Canton Street, Norwood, MA 02062, 2009.
2. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley & Sons (2001).
3. B.Hoffmann- Wellenhof, GPS theory and practice, 5th Edition, Springer 2001.

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RADAR ENGINEERING

Course Objectives: To provide an insight into the basic concepts of

- RADAR engineering.
- MTI and Pulse Doppler Radar.
- Tracking Radar.
- block diagrams of Synthetic Aperture Radar (SAR), Phased array Radars and others.
- different radar receiver principles of direction finders

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

- Understand the basic concepts of RADAR engineering
- Understand the basic concepts of MTI and Pulse Doppler Radar
- Analyze Tracking Radar
- Examine block diagrams of Synthetic Aperture Radar (SAR), Phased array Radars and others.
- Examine different radar receiver principles of direction finders.

SYLLABUS

Introduction to RADAR: Radar Equation, Radar Block Diagram and Operation, Prediction of Range, Minimum Detectable Signal, Receiver Noise, Probability Density Functions, S/N, Integration of Radar Pulses, Radar Cross-section, Transmitter Power, PRF and Range Ambiguities, Radar Antenna Parameters, System Losses and Propagation Effects.

MTI and Pulse Doppler RADAR: Introduction, Delay line Cancellers, Moving target Detector, Limitation to MTI performance, MTI from moving platform, Pulse Doppler Radar

Tracking RADARS: Sequential Lobing, Conical Scan, Monopulse tracking Radar, Low angle tracking, Pulse compression, Block Diagrams of Synthetic Aperture Radar (SAR), Phased array Radars, MST Radar, ECM, ECCM.

Detection of Signals in Noise: Matched Filter Receiver, Detection Criteria, Constant False Alarm Rate Receivers. Information From RADAR Signals: Basic Radar Measurements, Pulse Compression, Target Recognition.

RADAR Transmitters and Receivers: Magnetron, Solid State RF Power Source, Other Aspects of Radar Transmitters, Radar Receiver, Superheterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays.

Text Book:

1. Radar Engineering and Fundamentals of Navigational Aids, G S N Raju, IK International Publishers, 2008

Reference Book:

1. Introduction to Radar Systems, Skolnik, McGraw Hill, 2007.

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CELLULAR AND MOBILE COMMUNICATION

Course Objectives: The objectives of this course are

- To know the evolution of Mobile communication and cell concept to improve capacity of the system.
- Understand the basic cellular concepts like frequency reuse, cell splitting, cell sectoring etc., and various cellular systems.
- Understand the frequency management, channel assignment, various propagation effects in cellular environment and the concepts of handoff and types of handoffs.
- Understand the architectures of GSM and 3G cellular systems.

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

- Explain the fundamentals of cellular radio system design and its basic elements.
- Analyze the concepts of different co-channel, non-co-channel interference and cellular coverage on signal & traffic of a designed system.
- Identify the various types of multiplexing and modulation techniques suitable for mobile communications.
- Distinguish the number of radio channels, channel assignment and frequency management used in mobile communications and analyze the different hand off & cell splitting techniques and dropped call rate at cell site area
- Analyze small scale fading
- Summarize the different types of second-generation system architectures such as GSM, TDMA and CDMA for mobile communication systems.

SYLLABUS

Introduction: Evolution of Mobile Communications, Mobile Radio Systems around the world, First, Second, Third Generation Wireless Networks, Wireless Local Loop (WLL), Wireless

LANs, Bluetooth, Personal Area Networks (PANs), Examples of Wireless Communication Systems, A Simplified Reference Model, Applications.

Wireless Transmission Techniques: Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation Techniques: ASK, PSK, FSK, Advanced ASK, Advanced PSK, Multicarrier, Spead Spectrum: Direct sequence and Frequency hopping, Medium Access control- SDMA, FDMA, TDMA, CDMA, Comparison of S/F/T/CDMA.

The Cellular Concept: Introduction, Frequency reuse, Handoff strategies, Interference and System Capacity: Co- Channel Interference, Channel Planning, Adjacent Channel Interference, Power control for reducing interference, Trunking and Grade of Service, Cell Splitting, Sectoring, Repeaters for Range extension, A microcell zone concept.

Mobile Radio Propagation: Introduction, Free space propagation model, The three basic propagation models-Reflection, Diffraction and Scattering, Two-ray model, Outdoor propagation models, Indoor propagation models, Signal Penetration into building, Small scale multipath Propagation, Parameters of Mobile multipath channels, Types of small scale fading.

Telecommunication Systems: GSM: Mobile Services, System Architecture, Radio interface, Protocols, Localization and Calling, Handover, Security, New data services, UMTS and IMT-2000: Releases and Standardization, System Architecture, Radio interface, UTRAN, Handover.

Text Books:

1. Mobile Cellular Communication by Gottapu Sasibhushana Rao, PEARSON International, 2012.

Reference Books:

1. Mobile Communications-Jochen Schiller, Pearson education, 2nd Edn, 2004.
2. Wireless Communications: Principles and Practice-Theodore. S. Rapport, Pearson education, 2nd Edn, 2002.
3. Mobile Cellular Telecommunications-W.C.Y.Lee, Tata McGraw Hill, 2nd Edn, 2006.
4. Wireless and Mobile Communications-Lee, McGraw Hill, 3rd Edition, 2006.
5. Wireless Communications and Networks-William Stallings, Pearson Education, 2004.

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ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Course Objectives: The objectives of this course are

- To introduce the fundamentals of Electronics Instruments and Measurement
- To provide an in-depth understanding of Measurement errors.
- To address the underlying concepts and methods behind Electronics measurements.
- To understand operation of different instruments.
- To know the principles of various types of transducers and sensors.

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

- Understand the different characteristics of electronic measuring instruments.
- Make use of Signal generators to analyze a signal.
- Understand the design and functioning of Oscilloscopes.
- Utilize AC bridges for measurement of inductance.
- Distinguish active transducers from passive transducers.
- Develop the ability to use instruments for measurement of physical parameters.

SYLLABUS

Basic Measurement Concepts: Measurement systems – Static and dynamic characteristics – error analysis – moving coil meters – DC ammeters, DC voltmeters, Series type ohmmeter, Shunt type ohmmeter, multimeter - moving iron meters – Bridge measurements – Wheatstone, Kelvin, Guarded Wheatstone, Maxwell, Hay, Schering, Anderson and Wein bridge.

Basic Electronic Measurements: AC voltmeters using rectifiers, True RMS responding voltmeter, Electronic multimeter – Comparison of analog and digital techniques – digital voltmeter - Ramp, Stair case ramp, Integrating, Continuous balance, Successive approximation.

Digital Instruments: Frequency counters – measurement of frequency and time interval – extension of frequency range – measurement errors - Cathode ray oscilloscopes – block schematic – applications – special oscilloscopes – Storage and sampling oscilloscopes – wave analyzer - distortion analyzer - spectrum analyzer – Q meters.

Transducers: Introduction, Classification of transducers, Analog transducers, Resistive transducers, Potentiometers, Strain gauges, Types of strain gauges, Resistance strain gauges, Semiconductor strain gauges, Resistance thermometers, Thermometers, Application of Thermistors, Thermo-couple construction, Measurement of thermocouple output, Compensating circuits, Advantages and disadvantages of thermocouples, Variable inductance type transducer, Variation of self-inductance, Variation of mutual inductance, Linear variable differential transformer, Rotary variable differential transformer, Capacitive transducers, Piezo-electric transducers, Digital transducers, Shaft Encoder.

Text Books:

1. Albert D. Helfrick and William D. Cooper – Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India, 2003.
2. A K Sawahney, Electrical And Electronics Measurement and Instrumentation, Dhanpat Rai,2000

Reference Books:

1. H S Kalsi, Electronic instrumentation, TMH, 1995.
2. Ernest O. Doebelin, Measurement Systems- Application and Design-Tata McGraw-Hill-2004.
3. Oliver B.M. & Cage – Electronic Measurements & Instrumentation -Tata McGraw Hill
4. K Padma Raju,Y J Reddy, Instrumentation and Control Systems, McGraw Hill Education,2016.

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MICROELECTRONICS

Course Objectives: The objectives of this course are

- To explain and apply basic concepts of semiconductor physics relevant to devices.
- To describe, explain, and analyse the operation of important semiconductor devices in terms of their physical structure.
- To realize the combinational and sequential circuits using semiconductors.
- To design - confront integrated device and/or circuit design problems, identify the design issues, and develop solutions.

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

- Understanding the fabrication process of BJT, FET and MOS technologies.
- Analyze the basic digital circuits.
- Make use of combinational circuits to implement combinational logic functions.
- Develop different types of counters and registers using flip-flops.

SYLLABUS

Integrated- Circuit Fabrication: Monolithic Integrated - Circuit (microelectronics) technology- The planar processes - Bipolar Transistor Fabrication - Fabrication of FETs - CMOS Technology - Monolithic Diodes - The Metal – Semiconductor Contact - IC Resistor - IC Capacitors - IC Packaging - Characteristics of IC Components – Microelectronic circuit layout.

Basic Digital circuits: MOS Technology - NMOS, CMOS, Inverters, Logic gates - ECL circuits.

Combinational Circuits: Arithmetic functions - Comparators - Multiplexers - Demultiplexers - Memory - Memory applications – PAL - PLAs.

Sequential Circuits: A1 - Bit memory - The circuits properties of biastable latch - The clocked SR Flip-Flop - J-K, T, and D-type Flip-flops. Shift-registers - Ripple Counters - synchronous counters - Applications of counters.

Text Book:

1. Microelectronic by JocobMilliman, ArbinGrabel second edition, TMH.

Reference Books:

1. Part 2 of Integrated Circuits, Design Principles and Fabrications by editors, Warner and Fordemwalt, 1965, Motorola Series, McGraw Hill.
2. MOS LSI Design and Applications by Dr. William N. Carr and Dr. Jack P. Mize, McGraw Hill, 1972.
3. Microelectronic circuits and devices second edition Horenstien, PHI.

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EMI/EMC

Course Objectives: The objectives of this course are

- To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC
- To understand EMI sources and its measurements
- To understand the various techniques for electromagnetic compatibility.
- Acquire broad knowledge of various EM radiation measurement techniques.
- Model a given electromagnetic environment/system so as to comply with the standards.

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

- Understand the EMI sources, EMC regulations and methods of eliminating interferences.
- Identifying of EMI hotspot and various techniques like Grounding, Shielding, Cabling.
- Analyze the effect of EM noise in system environment and its sources.
- Summarize the EMC design constraints and make appropriate trade-offs that meets all requirements.
- Designing electronic systems that function without errors or problems related to electromagnetic compatibility.
- Differentiate various EMI measurement techniques.

SYLLABUS

Introduction to EMI/EMC: EMI Sources, EMI Coupling, Noise Path, Models of Noise Coupling, EMC Regulations, Designing for EMC, Compliance Tests, Elimination of EMI, EMI Testing, Compliance Test and Engineering Tests.

Grounding Techniques: Grounding Techniques, Shielding Techniques, Cabling Techniques.

Conducted EMI/EMC: Origin of Conducted EMI, Common and Normal mode Noise, Noise from Power Electronic Systems, Spectra of Pulse Noise Sources, Modeling of EMI Noise Sources, Transient Disturbance Simulation Signals, EMI Filters for Mains Noise.

Choice of Passive Components: EMC Design Components

EMI Measurement Technology: EMI Measuring Instruments, Pitfalls of EMI Measurements, Test Instrumentation Accessories and their Characteristics, Measurement of Pulsed EMF, EMI Patterns from Different List Objects, EMI Immunity Test System, Software in EMI/EMC Measurements, Recent Trends in Susceptibility Measurement, Cost Effective EMI/EMC Measurements, Setup and its Maintenance.

Text Books:

1. IMPACT Learning Material Series Modules 1 – 9, IIT New Delhi, Published by RSTE.
2. Electromagnetic Compatibility, R. C. Paul.

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INTERNET AND WEB TECHNOLOGY

Course Objectives: The objectives of this course are

- To understand best technologies for solving web client/server problems.
- To analyze and design real time web applications.
- To use Java script for dynamic effects and to validate form input entry.
- To Analyze to Use appropriate client-side or Server-side applications.

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

- Understand the concepts of HTML, Java scripts and Cascading Style Sheets
- Generate XML documents and Schemas and summarize Java Beans.
- Develop and deploy real time web applications in web servers and Servlets.
- Build JSP tools that assist in automating data transfer over the Internet.
- Accessing a Database from Servlets & JSP Page.

SYLLABUS

HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets; Java Script: - Introduction to Java Scripts, Objects in Java Script**,** Dynamic HTML with Java Script

XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX.

Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK, Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API, Introduction to EJB's

Web Servers and Servlets: Tomcat web server, Introduction to Servlets: Lifecycle of a Server let, The Servlet API, The javax.servelet Package, Reading Servlet parameters, and Reading Initialization parameters. The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues

JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing – Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data between JSP pages, Requests, and Users Passing Control and Date between Pages – Sharing Session and Application Data – Memory Usage Considerations

Database Access: Database Programming using JDBC, Studying Javax.sql.* package, Accessing a Database from Servlets & JSP Page , Application – Specific Database Actions, Deploying JAVA Beans in a JSP Page, Introduction to struts framework.

Text Books:

1. Internet and World Wide Web – How to program by Dietel and Nieto
   PHI/Pearson Education Asia.
2. Advanced Java™ 2 Platform How to Program, Deitel/Deitel/Santry 3. Java Server Pages – Hans Bergsten, SPD O'Reilly

Reference Books:

1. HTML Black Book: The Programmer's Complete HTML Reference Book-by Steven Holzner
2. Core Servelets and Java Server Pages Volume2: Core Technologies by Marty Hall and Larry Brown, Pearson Education.

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INFORMATION THEORY AND CODING

Course Objectives: To provide an insight into the basic concepts of

- The concept of Error control coding
- Linear Block Codes for Error Correction.
- Convolution coding to improve the reliability of the system
- Sequential Decoding of Convolution codes

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

- Understand the concept of Error control coding
- Apply Linear Block Codes for Error Correction
- Apply Convolution coding to improve the reliability of the system
- Sequential Decoding of Convolution codes

SYLLABUS

Information Theory: Information measure, Entropy and Information rate, Coding for a discrete memory less source, Predictive coding for sources with memory, Information transmission on discrete channels, Mutual information.

Information Channels: Discrete channel capacity, coding for the binary symmetric channel, Continuous channels and system comparisons, continuous information, continuous channel capacity, Ideal communication system, system comparisons.

Error Controlling Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. **Binary Cyclic Codes:** Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction

Convolution Coding: Practical Convolution Encoder, Time Domain Approach, Transform Domain Approach, The Code Tree, Code Trellis, State Diagram, Decoding Methods of Convolution Codes, Sequential Decoding, Burst Error Detection and Correction Codes, Concatenated Block Codes, Turbo Codes.

Text Books:

1) Communication Systems,3/e, by A.B. Carlson, Mc. Graw Hill Publishers (for topic1)
2) Digital Communications by Simon Haykin, John Wiley & Sons (for topic 2).
3) Principles ofDigital Communication, J. Das, S.K.Mullick, P. K. Chatterjee, Wiley, 1986-Technology &Engineering.
4) Information Theory and Coding, HariBhat, Ganesh Rao, Cengage, 2017.

Reference Books:

1) Principles of Digital Communications, Signal representation, Detection, Estimation &Information
2) Coding by J Das, S.K. Mullick, P.K.Chatterjee, New Age Int. Ltd.
3) Principles of Communication Systems, Taub &Schilling, 2/e, TMH Publisher.

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SMART ANTENNAS SYSTEMS

Course Objectives: The objectives of this course are

- To know the basic concepts on antenna
- To know the performance of an antenna array
- Learning self-adaptive procedure to extract the desired signal
- Design of smart antenna system

Course Outcomes: By the end of the course the student will be able to

- Understand antenna theory and application of signa processing in it.
- Learn techniques of developing MIMO antennas, beam forming.
- Design practical antennas for Radar applications.
- Determine the capacity and data rate in MIMO system

Syllabus

Smart Antennas: Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

DOA Estimation Fundamentals: Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Autocovariance, Conventional DOA Estimation Methods, Conventional Beamforming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, MUSIC Algorithm, ESPRIT Algorithm, Uniqueness of DOA Estimates.

Beam Forming Fundamentals: Classical Beam former, Statistically Optimum Beamforming Weight Vectors, Maximum SNR Beam former, Multiple Sidelobe Canceller and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beamforming

Integration and Simulation of Smart Antennas: Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms, DOA, Adaptive Beam forming, Beam forming and Diversity Combining for Rayleigh-Fading, Channel, Trellis-Coded Modulation (TCM) for Adaptive Arrays, Smart Antenna Systems for Mobile Adhoc Networks (MANETs), Protocol, Simulations, Discussion.

Space–Time Processing: Introduction, Discrete Space–Time Channel and Signal Models, Space– Time Beamforming, Inter symbol and Co-Channel Suppression, Space–Time Processing for DSCDMA, Capacity, and Data Rates in MIMO Systems, Discussion.

Text Books:

1. Constantine A. Balanis & Panayiotis I. Ioannides, "Introduction to Smart Antennas", Morgan & Claypool Publishers' series-2007
2. Joseph C. Liberti Jr., Theodore S Rappaport, "Smart Antennas for Wireless CommunicationsIS-95 and Third Generation CDMA Applications", PTR – PH publishers, 1st Edition, 1989.

Reference Books:

1. T.S Rappaport, "Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location", IEEE press 1998, PTR – PH publishers 1999.
2. Lal Chand Godara, "Smart Antennas", CRC Press, LLC-20.

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TV AND SATELLITE COMMUNICATION

Course Objectives: To provide an insight into the basic concepts of

- basic television system.
- With examples of Signal Transmission and Channel Bandwidth
- Television Receiver and Colour Television
- various concepts of satellite communication.

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

- Analyze the concepts of basic television system.
- Illustrate examples of Signal Transmission and Channel Bandwidth.
- Infer Television Receiver and Colour Television.
- Infer various concepts of satellite communication.

SYLLABUS

Basic Television System: Sound and Picture Transmission, the Scanning Process, Interlaced Scanning, Number of Scanning Lines, Vertical and Horizontal Resolution, Bandwidth of the Baseband Picture Signal.

Television Cameras: Principle of working and constructional details of Image Orthicon, Vidicon, Plumbicon and Silicon diode array Vidicon and Solid-state Image Scanners.

Composite - Video Signal: Video signal levels, Need for Synchronization, Details of Horizontal and Vertical Sync Pulses, Equalizing Pulses.

Signal Transmission and Channel Bandwidth: AM and FM Channel Bandwidth, VSB Transmission, Complete Channel Bandwidth, Reception of Vestigial Sideband Transmission, Television Standards, Block Schematic study of a typical TV Transmitter.

The TV Picture Tube: Monochrome Picture Tube, Picture Tube Characteristics and Picture Tube Control Circuits, Gamma Correction. **Television Receiver:** Block Schematic and Functional Requirements, VSB Correction.

Vertical and Horizontal Deflection Circuits, E.H.T. Generation, Study of Video IF Amplifier Video Detector, Sound Channel Separation, Sync Separation Circuits.

Colour Television: Principles of Additive and Subtractive Colour Mixing, Chromaticity Diagram, Compatibility and Reverse Compatibility of Colour and Monochrome TV Requirements, Colour Signal Transmission, Bandwidth for Colour Signal Transmission, Sub-carrier Modulation of Chroma Signals, NTSC Encoding (Y, I, Q signals), PAL Encoding (Y, U, V signals), NTSC and PAL Decoders, Types of Colour TV Picture Tubes (Delta-gun, PIL and Trinitron Picture Tubes), Convergence Techniques.

Satellite Communication: Orbital Aspects, Tracking and Control of Communication Satellites, Launch Vehicles, Propagation Characteristics: Attenuation and Noise, Frequency Bands, Satellite Transponders, Earth Station: Configuration, High Power Amplifiers, Antennas, LNA, Link Design, Multiple Access: FDMA, TDMA, CDMA, SPADE, INTELSATs, INSAT.

Text Books:

1. Global Navigation Satellite Systems with Essentials of Satellite Communications authored by G S Rao, Mc-Graw Hill Publication, New Delhi 2010
2. Monochrome and Colour Television, R. R. Gulati, Wiley Eastern.

Reference Books:

1. Television Engineering, A. M. Dhake, Tata - McGraw Hill.
2. Satellite Communication, D. C. Agarwal, Khanna Publishers.
3. Satellite Communication, T. Pratt and S. W. Bostian, John Wiley and Sons.

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TRANSDUCERS AND SIGNAL CONDITIONING

Course Objectives: The objectives of this course are

- To understand the necessity and advantages of transducer.
- To learn the operation and applications of various transducer.
- To design and construct different transducers.
- To measure several parameters using transducers.

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

- Understand study about the concepts of measurement, error and uncertainty, transducer classification, terminology, static and dynamic characteristics of transducers.
- Gain knowledge on working principle construction, operation, characteristics and features of different transducers.
- Understand the concepts of signal conversion and signal conditioning methods for different transducers.
- Understand the selection criteria of transducer for particular application and use the same for developing the applications.

SYLLABUS

Introduction: Measurement systems, Basic electronic measuring system, Transduction principles, Classification of transducers, General transducers characteristics, Criteria for transducer selection.

Resistive Transducers: Principles of operation, construction, theory, advantages and disadvantages, applications of Potentiometers, strain gauges, (metallic and semi-conductor type), Resistance Thermometer, Thermistors.

Inductive Transducers: Types of Inductive transducer, Principles of operation, construction, Advantages & disadvantages and applications. Various variable Inductive Transducers, LVDT (Linear variable differential transformer).

Capacitive Transducers: Types of capacitive transducer, Principles of operation, construction, theory, advantages and disadvantages and applications, of capacitive transducers based upon familiar equation of capacitance.

Elastic Transducers: Spring bellows, diaphragm, bourdon tube – their special features and application.

Active Transducers: Principle of operation, construction, theory, advantages and disadvantages and applications of following transducers: Thermocouple, Piezo-electric transducer, Magneto-strictive transducer, Hall effect transducer, Photo-voltaic transducer and electrochemical transducer.

Other Transducers: Optical transducers: photo-emissive, photo-conductive and Photovoltaic cells, Digital Transducers: Optical encoder, Shaft encoder. Feedback fundamentals, introduction to Inverse transducer.

Signal Conditioning: Concept of signal conditioning, Applications of AC/DC Bridges, Application of Op-amp circuits used in instrumentation, Instrumentation amplifiers, Interference, grounding, and shielding.

Text Books:

1. Murty DVS, "Transducers & Instrumentation", Prentice Hall of India
2. Sawhney AK, "Electrical and Electronics Measurements and Instrumentation," Dhanpat Rai and Sons
3. Kalsi HS, "Electronic Instrumentation," Tata McGraw Hill
4. Patranabis D, "Sensors and Transducers," Prentice Hall of India 5. Doebelin EO, "Measurement Systems: Application and Design," Tata McGraw Hill

Reference Books:

1. H.K.P. Neubert Instrument Transducers Oxford University Press : (Second edition).

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LOW POWER VLSI DESIGN

Course Objectives: The objectives of this course are

- This course addresses a profound analysis on the development of the CMOS & Bi-CMOS digital circuits for a low voltage low power environment
- To study the concepts of device behavior and modeling
- To study the concepts of low voltage, low power logic circuits
- To understand the concepts of Low Power Latches and Flip Flops

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

- Capability to recognize advanced issues in VLSI systems, specific to the deep-submicron silicon technologies.
- Students able to understand deep submicron CMOS technology and digital CMOS design styles.
- To design chips used for battery-powered systems and highperformance circuits
- Explain the equations, approximations and techniques available for deriving a device model with specified properties
- Explore and improvise on the latest techniques used for designing power-efficient logic gates, latches, and flip-flops

SYLLABUS

Low Power Design, An Over View: Introduction to low- voltage low power design, limitations, Silicon-on-Insulator.

MOS/ Bi CMOS PROCESSES: Bi CMOS processes, Integration and Isolation considerations, Integrated Analog/Digital CMOS Process. Deep submicron processes, SOI CMOS, lateral BJT on SOI, future trends and directions of CMOS/ Bi CMOS processes.

Device Behavior And Modeling: Advanced MOSFET models, limitations of MOSFET models,

bipolar models. Analytical and Experimental characterization of sub-half micron MOS devices, MOSFET in a Hybrid mode environment.

CMOS and Bi-CMOS Logic Gates: Conventional CMOS and Bi CMOS logic gates. Performance evaluation.

Low- Voltage Low Power Logic Circuits: Comparison of advanced BiCMOS Digital circuits. ESD-free Bi CMOS, Digital circuit operation and comparative Evaluation.

Low Power Latches and Flip Flops: Evolution of Latches and Flip flops-quality measures for latches and Flip flops, Design perspective.

Text Books:

1. CMOS/Bi CMOS ULSI low voltage, low power by Yeo Rofail / Gohl (3 Authors)-Pearson Education Asia 1st Indian reprint,2002

Reference Books:

1. Digital Integrated circuits, J.Rabaey PH. N.J 1996
2. CMOS Digital ICs sung-moKang and yusufleblebici 3rd edition TMH2003 (chapter 11)
3. VLSI DSP systems, Parhi, John Wiley & sons, 2003 (chapter 17)
4. IEEE Trans Electron Devices, IEEE J.Solid State Circuits, and other National and International Conferences and Symposia.

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DIGITAL IMAGE PROCESSING

Course Objectives: The objectives of this course are

- To familiarize with basic concepts of digital image processing and different image transforms
- To learn various image processing techniques like image enhancement, restoration, segmentation and compression
- To understand color fundamentals and different color models.
- To understand wavelets and morphological image processing.

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

- Illustrate the fundamental concepts of Digital Image Processing and different image transforms.
- Analyze the effect of spatial and frequency domain filtering of images.
- Evaluate the methodologies for image restoration and reconstruction.
- Compare the different color image processing techniques.
- Elucidate the mathematical modelling of image Multi-resolution processing and apply different image compression techniques.
- Categorize different image segmentation techniques and morphological image operations.

SYLLABUS

Introduction: Origins of digital image processing, uses digital image processing, fundamental steps in digital image processing, components of an image processing system, digital image fundamentals, Elements of visual perception, light and electromagnetic spectrum, imaging sensing and acquisition, image sampling and quantization. Some basic relationships between pixels, and introduction to the mathematical tools used in digital image processing.

Image Transforms: Need for image transforms, Spatial Frequencies in image processing, introduction to Fourier transform, discrete Fourier transform, fast Fourier transform and its

algorithm, properties of Fourier transform. Discrete sine transforms. Walsh Transform. Hadamard transform, Haar Transform. Slant transforms, SVD and KL Transforms or Hotelling Transform

Intensity Transformations and Spatial Filtering: Background, some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, combining spatial enhancement methods, using fuzzy techniques for intensity transformations and spatial filtering.

Filtering in the frequency domain: Preliminary concepts, Sampling and the Fourier transform of sampled functions, the discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform. The Basic of filtering in the frequency domain, image smoothing using frequency domain filters, Selective filtering, Implementation.

Image restoration and Reconstruction: A model of the image degradation /Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimation the degradation function, Inverse filtering,

Minimum mean square error (Wiener) filtering, constrained least squares filtering, geometric mean filtering, image reconstruction from projections.

Color image processing: color fundamentals, color models, pseudo color image processing, basic of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

Wavelets and Multi-resolution Processing: image pyramids, sub band coding & Haar transforms multi resolution expressions, wavelet transforms in one dimension. The fast wavelets transform, wavelet transforms in two dimensions, wavelet packets.

Image compression: Fundamentals, various compression methods-coding techniques, digital image water marking.

Morphological image processing: preliminaries Erosion and dilation, opening and closing, the Hit-or-miss transformation, some Basic Morphological algorithms, grey –scale morphology

Image segmentation: Fundamentals, point, line, edge detection thresholding, region –based segmentation, segmentation using Morphological watersheds, the use of motion in segmentation**.**

Text Books:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. R. C. Gonzalez, R. E. Woods and Steven L. Eddins , Digital Image Processing Using MATLAB , 2rd edition, Prentice Hall, 2009.
3. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
4. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, Tata McGraw-Hill Education.

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FIBER OPTIC COMMUNICATIONS

Course Objectives: The objectives of this course are

- To realize the significance of optical fibre communications.
- To understand the construction and characteristics of optical fibre cable.
- To develop the knowledge of optical signal sources and power launching.
- To identify and understand the operation of various optical detectors.
- To understand the design of optical systems and WDM.

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

- Understand and analyze the constructional parameters of optical fibres.
- Be able to design an optical system.
- Estimate the losses due to attenuation, absorption, scattering and bending.
- Compare various optical detectors and choose suitable one for different applications.

SYLLABUS

Overview of Optical Fiber Communication: - Historical development, The general system, Advantages of Optical Fiber Communications, Optical Fiber Wave Guides- Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Cylindrical Fibers- Modes, V number, Mode Coupling, Step Index Fibers, Graded Index Fibers.

Single Mode Fibers- Cut Off Wavelength, Mode Field Diameter, Effective Refractive Index, Fiber Materials Glass, Halide, Active Glass, Chalgenide Glass, Plastic Optical Fibers.

Signal Distortion in Optical Fibers: Attenuation, Absorption, Scattering and Bending Losses, Core and Cladding Losses, Information Capacity Determination, Group Delay, Types of

Dispersion - Material Dispersion, Wave-Guide Dispersion, Polarization Mode Dispersion, Intermodal Dispersion, Pulse Broadening, Optical Fiber Connectors- Connector Types, Single Mode Fiber Connectors, Connector Return Loss.

Fiber Splicing: Splicing Techniques, Splicing Single Mode Fibers, Fiber Alignment and Joint Loss- Multimode Fiber Joints, Single Mode Fiber Joints. Optical Sources- LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Injection Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies, Reliability of LED & ILD.
Source to Fiber Power Launching: - Output Patterns, Power Coupling, Power Launching, Equilibrium Numerical Aperture, Laser Diode to Fiber Coupling

Optical Detectors: Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical Receiver Operation- Fundamental Receiver Operation, Digital Signal Transmission, Error Sources, Receiver Configuration, Digital Receiver Performance, Probability of Error, Quantum Limit, Analog Receivers.

Optical System Design: Considerations, Component Choice, Multiplexing, Point-to- Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion in Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples. Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye Pattern.

Text Books:

1. Optical Fiber Communications – Gerd Keiser, MC GRAW HILL EDUCATION, 4th Edition, 2008.
2. Optical Fiber Communications – John M. Senior, Pearson Education, 3rd Edition, 2009.

Reference Books:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.

2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005. 3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004. 4. Introduction to Fiber Optics by Donald J.Sterling Jr. – Cengage learning, 2004.

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ADVANCED MICROPROCESSORS

Course Objectives: The objectives of this course are

- To describe the function of the microprocessor and detail its basic operation
- To understand the concepts of advanced architecture in the microprocessors
- To describe the function and purpose of each program-visible registers in microprocessor
- To interface memory devices with 80186,80286,80386 and 80486.

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

- understand the functionality of 80186,80286,80386 and 80486 architecture to design advanced microprocessors systems
- Analyze the Performance of RISC and CISC architectures.
- Interface the advanced processors with Memory.
- Summarize the interfacing rules of different peripherals with advanced microprocessor.

SYLLABUS

80386 Architecture: Instruction set - Addressing modes - Real mode - Protected mode - 80386 Architecture - Address segmentation - Paging - Segment registers.

Basic 486 Architecture: 486 memory system and memory management - Features of Pentium memory and I/O systems - Pentium memory management - Introduction to Pentium Pro features.

High Performance CISC Architecture – Pentium: CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

High Performancerisc RISC Architecture – ARM Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors - ARM instruction set- Thumb Instruction set - **Instruction cycle timings**: The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming – Optimizing ARM Assembly Code – Optimized Primitives.

Memory Interface: Memory Devices, Address Decoding, 8086, 80186,80286,80386SX Memory Interface, 80286DX and 80486 Memory Interface, Pentium through core2 Memory Interface

Reference Books:

1. The Intel Microprocessors 8086 / 8088, 80186, 80188, 80286, 80386, 80486, Pentium and Pentium – Pro Processor Architecture, Programming and Interface by Barray B. Berry, 4th Edition, PHI.
2. Microprocessors Principles and Applications by Gilmore, 2nd Edition, TMH.
3. Microprocessors and Interfacing Programming and Applications by Douglas V. Hall, Mc Graw Hill.
4. Microprocessors / Microcomputers Architecture, Software and Systems by A.J. Khambata, John Wiely & Sons.
5. Advanced Microprocessors by Daniel Tabak, Mc Graw Hill, 1995.

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ANNEXURE-II

OPEN ELECTIVES

1. VLSI Design
2. Wireless Sensor Networks
3. Computer Networks
4. DSP Processors and Architectures
5. Embedded System Design
6. Bio-Medical Instrumentation
7. Mobile Communications
8. FPGA Design
9. Speech Processing
10. Control Systems
11. Internet of Things and Applications
12. Artificial Neural Networks

VLSI DESIGN

Course Objectives: To provide an insight into the basic concepts of

- VLSI technology
- circuit design processes with stick diagrams and layout diagrams.
- VLSI circuit
- scaling of MOS circuits with sub system design and layout

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

- Describe the basic concepts of VLSI technology.
- Demonstrate circuit design processes with stick diagrams and layout diagrams
- Demonstrate basic circuit concepts.
- Summarize scaling of MOS circuits with sub system design and layout.

SYLLABUS

Review of microelectronics and an introduction to MOS technology: Introduction to IC technology, MOS and related VLSI technology, NMOS, CMOS, BiCMOS Technologies, Thermal aspects of processing, Production of E beam marks.

MOS and BiCMOS circuit design processes: MOS layers, Stick diagrams, Design rules, and layout, 2 & 1.2 micro meter CMOS rules, Layout diagrams, Symbolic diagram.

Basic Circuit concepts: Sheet resistance, Area capacitances of layers, Delay unit, Wiring Capacitances, Choice of layers.

Scaling of MOS Circuits: Scaling models, Scaling function for device parameters, Limitations of scaling.

Sub system design and Layout: Architectural issues, Switch logic, Examples of Structural design(Combinational logic).

Sub system design process: Design of ALU subsystem, Some commonly used storage elements, Aspects of design tools, Design for testability, Practical design for test guidelines, Built in self test, CMOS project-an incrementer / decrementer, a comparator for two n-bit numbers. Ultra fast systems, Technology development, MOSFET based design.

Introduction to Embedded Systems: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software in a System, Examples of Embedded Systems, Embedded Systems on Chip, Complex Systems Design and Processors, Design Process in Embedded System, Formalization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills required for an Embedded System Designer.

Embedded Software Development Process and Tools: Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-design

Text books:

1. Basic VLSI Design by Douglas A, Pucknell, Kamran Eshraghian, Prentice-Hall, l996, 3rd Edition.
2. Embedded Systems Architecture, Programming and Design, second edition by Raj Kamal, Tata McGraw Hill Publication (Chapter 1, Chapter 13)

Reference Books:

1. Mead, C.A and Conway, LA, “Introduction to VLSI Systems”, Addison-Wesley, Reading, Massachusetts, l980.

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WIRELESS SENSORS & NETWORKS

Course Objectives: The objectives of this course are

- To understand the WSN node Architecture and Network Architecture.
- To identify the Wireless Sensor Network Platforms.
- To design and develop wireless sensor node.
- To learn the concepts of layered protocols for WSN.

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

- Understand the fundamental Concepts, applications and architectures of wireless sensor networks
- Categorize the various network topologies.
- Realize the MAC Protocols for Wireless Sensor Networks.
- Describe routing protocols for ad hoc wireless networks with respect to TCP design issues.
- Outline the transport layer and security protocols for WSN.
- Differentiate various sensor network platforms and tools.

SYLLABUS

Overview of Wireless Sensor Networks: Key definitions of sensor networks, Advantages of sensor Networks, Unique constraints a challenge, Driving Applications, Enabling Technologies for Wireless Sensor Networks.

Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Networking Technologies: Physical Layer and Transceiver Design Considerations, Personal area networks (PANs), hidden node and exposed node problem, Topologies of PANs, MANETs, WANETs.

MAC Protocols for Wireless Sensor Networks: Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad-Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention – Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing.

Transport Layer and Security Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

Security in WSNs: Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks.

Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Applications of WSN: Ultra-wide band radio communication, Wireless fidelity systems. Future directions, Home automation, smart metering Applications.

Text Books:

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI

2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – Jagannathan Sarangapani, CRC Press
3. Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

Reference Books:

- KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh ,1 ed. Pearson Education.
4. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.
5. Wireless Sensor Networks – S Anandamurugan , Lakshmi Publications.

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COMPUTER NETWORKS

Course Objectives: The objectives of this course are

- To describe how computer networks are organized with the concept of layered approach.
- To implement a simple LAN with hubs, bridges and switches.
- To analyze the contents in a given Data Link layer packet, based on the layer concept.
- To design logical sub-address blocks with a given address block.
- To describe how routing protocols work.

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

- Understand the concepts of Network Topologies, structures and layers.
- Illustrate Physical layer Guided Transmission media and Multiplexing concepts.
- Understand how the Media Access control problem solved in a network using multiple access protocols.
- Detect and analyze the Datalink layer Framing, Error control Techniques and protocols in a network.
- Make use of the Network Layer routing algorithms, congestion control algorithms to perform better network communication.
- Analyze the internet Transport layer protocols and application layer services.

SYLLABUS

Introduction: Uses of Computer Networks, Network Structure, Architectures, Services, Standardization, Functions of Various Network Layers, Network examples.

Physical layer: Theoretical Basis for Data Communication, Transmission Media, Analog and Digital Transmission, Transmission and Switching ISDN.

Medium Access Sub-layer: LAN, MAN, Protocol, ALOHA, IEEE Standard for 802 for LANs, Fiber Optic Networks, Satellite Networks.

Data Link layer: Design Issues, Error Detection and Correction, Protocols and their Performance, Specifications and Examples.

Network layers: Design Considerations, Difference between Gateway, Ethernet Switch, Router, Hub, Repeater, Functions of Router, Congestion Control Internetworking and Examples, Details of IP addressing schemes, TCP/IP Protocol details.

The Transport Layer: The Transport Service, Elements of Transport Protocols, The Internet Transport Protocols; UDP, The Internet Transport Protocols; TCP.

The Application Layer: The Domain Name System, Electronic Mail, The World Wide Web.

Text Books:

1. Data Communications and Networking by Behrouz A. Forouzan, 2nd Edition, Tata McGraw Hill.

Reference Books:

1. Computer Networks, A. S. Tannenbaum, PHI – New Delhi.
2. Computer Networking Terminology Products and Standards, R. P. Suri and J. K. Jain, Tata McGraw Hill.

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DSP PROCESSORS & ARCHITECTURES

Course Objectives: The objectives of this course are

- To learn the architecture, addressing modes of DSP processors.
- To interface the serial converters to a DSP device
- To give an exposure to the various fixed point & a floating point DSP architectures and to develop applications using these processors.
- To know different basic DSP algorithms.

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

- Understand the concepts of DSP and numeric representations.
- Illustrate the architectural features of DSP devices.
- Determine various addressing modes and instructions of DSP processor.
- Analyze the concepts of basic DSP algorithms.
- Analyze the interfacing serial converters to a DSP device.

SYLLABUS

Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors,

Compensating filter.

Architectures for Programmable DSP Devices and Execution: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing, Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Implementations of Basic DSP Algorithms And FFT Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

Interfacing Memory And I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. S. Chand & Co, 2000.

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkata Ramani and M.Bhaskar, TMH, 2004.
2. Digital Signal Processing – Jonatham Stein, John Wiley, 2005.

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EMBEDDED SYSTEM DESIGN

Course Objectives: The objectives of this course are

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware, operating systems incorrelation with hardware systems.
- To understand the principles of sensors and actuators
- To understand parallel processing for multitasking systems

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

- Expected to understand the selection procedure of Processors in the embedded domain.
- Design Procedure for Embedded Firmware.
- Expected to visualize the role of Real time Operating Systems in Embedded Systems.
- Expected to evaluate the Correlation between task synchronization and latency issue

SYLLABUS

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS). **Memory:**

ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Text Books:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, MC GRAW HILL EDUCATION.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

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BIO MEDICAL INSTRUMENTATION

Course Objectives: The objectives of this course are

- To know the sources of Bioelectric potentials and Electrodes.
- To analyze the cardiovascular & Respiratory systems and its related measurements.
- To understand the various techniques for electromagnetic compatibility.
- To acquire knowledge of electronics in clinical laboratory and therapeutic area.

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

- Understand the origin of biopotentials and role of its electrodes.
- Elucidate the cardiovascular system and its measurements.
- Develop a thorough understanding on principles of Patient Care Monitory and Measurements in Respiratory System.
- Outline the concepts of Bio telemetry and Instrumentation for the clinical laboratory.
- Summarize the application of Electronics in diagnostics and therapeutic area.

SYLLABUS

Sources of Bioelectric potentials: Sources of Bioelectric potentials and Electrodes Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials Electrode theory, Bio Potential Electrodes, Biochemical Transducers

The Cardiovascular System: The Cardiovascular System and Cardiovascular Measurements, The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography, Measurement of Heart Sounds,

Patient Care and Monitoring: Patient Care & Monitory and Measurements in Respiratory System The elements of Intensive Care Monitory, Diagnosis, Calibration and repairability of Patient Monitoring equipment, other instrumentation for monitoring patients, pace makers, defibrillators The Physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment.

Biotelemetry: Bio telemetry and Instrumentation for the clinical laboratory Introduction to biotelemetry, physiological parameters adaptable to biotelemetry, the components of biotelemetry system, implantable units, applications of telemetry in patient care The blood, tests on blood cells, chemical test, automation of chemical tests

X-Ray and Radioisotope Instrumentation: X – ray and radioisotope instrumentation and electrical safety of medical equipment.

Generation of Ionizing radiation, instrumentation for diagnostic X – rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy. Physiological effects of electrical current, shock Hazards from electrical equipment, Methods of accident prevention

Text Book:

1. Biomedical Instrumentation and Measurements – C. Cromwell, F.J. Weibell, E.A. Pfeiffer Pearson education.

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MOBILE COMMUNICATIONS

Course Objectives: The objectives of this course are

- Understanding the basic principles of mobile communication systems.
- An analysis of mobile communications with the interpretation of the call prints.
- Understand the basic principles of the modern mobile and wireless communication systems.
- Understand the operation of mobile communications systems and their generation divisions.

Course Outcomes: At the end of the course the student will be

- Able to think and develop new mobile application.
- Able to take any new technical issue related to this new paradigm and come up with a solution(s).
- Able to develop new ad hoc network applications and/or algorithms/protocols.
- Able to understand & develop any existing or new protocol related to mobile environment.

SYLLABUS

Introduction: Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices. GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS.

Wireless Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN/

(IEEE 802.11)

Mobile Network Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Database Issues: Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process &QoS Issues.

Data Dissemination and Synchronization: Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software, and Protocols.

Mobile Ad hoc Networks (MANETs): Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc., Mobile Agents, Service Discovery.

Text Books:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley, Second Edition,2009.
2. Raj Kamal, "Mobile Computing", Oxford University Press, 2007, ISBN:0195686772

Reference Books:

1. ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, "Mobile Computing, Technology Applications and Service Creation" Second Edition, Mc Graw Hill.
2. UWE Hansmann, LotherMerk, Martin S. Nocklous, Thomas Stober, "Principles of Mobile Computing," Second Edition, Springer.

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FPGA DESIGN

Course Objectives: The objectives of this course are

- To prepare the student to be an entry-level industrial standard FPGA designer.
- To give the student an understanding of issues and tools related to FPGA design and implementation.
- To give the student an understanding of basics of System on Chip and Platform based design.
- To give the student the idea of FPGA routing structures

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

- Understand FPGA design flow.
- Identify the building blocks of commercially available FPGA/CPLDs.
- Develop VHDL/Verilog models and synthesize targeting for Vertex, Spartan FPGAs.
- Develop parameterized library cells and implement system designs using parameterized cells.

SYLLABUS

Introduction to FPGAs: Evolution of programmable devices, FPGA Design flow, Applications of FPGA.

Design Examples Using PLDs: Design of Universal block, Memory, Floating point multiplier, Barrel shifter.

FPGAs/CPLDs: Programming Technologies, commercially available FPGAs, Xilinx's Vertex and Spartan, Actel's FPGA, Altera's FPGA/CPLD.

Building blocks of FPGAs/CPLDs: Configurable Logic block functionality, Routing structures, Input/output Block, Impact of logic block functionality on FPGA performance, Model for measuring delay.

Routing Architectures: Routing terminology, general strategy for routing in FPGAs, routing for row – based FPGAs, introduction to segmented channel routing, routing for symmetrical FPGAs, example of routing in a symmetrical FPGA, general approach to routing in symmetrical FPGAs, independence from FPGA routing architectures, FPGA routing structures. FPGA architectural assumptions, the logic block, the connection block, connection block topology, the switch block, switch block topology, architectural assumptions for the FPGA

Text Books:

1. John V. Old Field, Richrad C. Dorf, Field Programmable Gate Arrays, Wiley, 2008.

2. Data sheets of Artix-7, Kintex-7, Virtex-7 .

3. Stephen D. Brown, Robert J. Francis, Jonathan Rose, Zvonko G. Vranesic, Field Programmable Gate Arrays, 2nd Edition, Springer, 1992.

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SPEECH PROCESSING

Course Objectives: The objectives of this course are

- To understand the basic principles of sound and speech production and perception.
- To understand basic principles of speech recognition, synthesis and dialogue systems
- To obtain an introductory overview in the field.
- To Evaluate the speech pattern similarities.

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

- Model an electrical equivalent of Speech Production system.
- Convey details of a range of commonly used speech feature extraction techniques.
- Provide a basic understanding of multidimensional techniques for speech representation and classification methods.
- Familiarize you with the practical aspects of speech processing, including robustness, and applications of speech processing, including speech enhancement, speaker recognition and speech recognition.
- Design a Homomorphic Vocoder for coding and decoding of speech

SYLLABUS

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

Time Domain Models for Speech Processing: Introduction- Window considerations, Short time energy and average magnitude Short time average zero crossing rate, Speech Vs Silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Linear Predictive Coding (LPC) Analysis: Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder. Speech Enhancement: Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach.

Automatic Speech & Speaker Recognition: Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System. Hidden Markov Model (HMM) for Speech: Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS. Speaker Recognition: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

Text Books:

- L.R. Rabiner and S. W. Schafer, "Digital Processing of Speech Signals", Pearson Education.
- Douglas O'Shaughnessy, "Speech Communications: Human & Machine", 2nd Ed., Wiley India, 2000.
- L.R Rabinar and R W Jhaung, "Digital Processing of Speech Signals", 1978, Pearson Education.

Reference Books:

- Thomas F. Quateri, “Discrete Time Speech Signal Processing: Principles and Practice”, 1st Edition., PE.
- Ben Gold & Nelson Morgan, “Speech & Audio Signal Processing”, 1st Edition, Wiley.

CONTROL SYSTEMS

Course Objectives: The objectives of this course are

- To introduce the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, and concepts of feedback.
- To study the characteristics of the given system in terms of the transfer function and introducing various approaches to reduce the overall system for necessary analysis.
- To develop the acquaintance in analyzing the system response in time-domain and frequency domain in terms of various performance indices.
- To analyze the system in terms of absolute stability and relative stability by different approaches.

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

- Develop the transfer function using block diagram algebra and signal flow graph methods.
- Construct the mathematical model of the physical feedback control systems.
- Realize the Time Domain Analysis of Control Systems.
- Analyze the Concepts and Necessary Conditions for Stability of control systems.
- Evaluate the stability of control systems using time and frequency response methods.
- Analyze system’s absolute, relative, local stability using different frequency domain methods.

SYLLABUS

Transfer Functions of Linear Systems – Impulse Response of Linear Systems – Block Diagrams of Control Systems – Signal Flow Graphs (Simple Problems) – Reduction Techniques for Complex Block Diagrams and Signal Flow Graphs (Simple Examples).

Time Domain Analysis of Control Systems – Time Response of First and Second Order Systems with Standard Input Signals – Steady State Error Constants – Effect of Derivative and Integral Control on Transient and Steady State Performance of Feedback Control Systems.

Concept of Stability and Necessary Conditions for Stability – Routh-Hurwitz Criterion, Relative Stability Analysis, the Concept and Construction of Root Loci, Analysis of Control Systems with Root Locus (Simple Problems to understand theory).

Correlation between Time and Frequency Responses – Polar Plots – Bode Plots – Log Magnitude versus Phase Plots – All Pass and Minimum Phase Systems – Nyquist Stability Criterion – Assessment of Relative Stability – Constant M and N Circles.

Text Books:

1.Automatic Control Systems, Benjamin C. Kuo, PHI Publication (5th Edition).

2. Control Systems Engineering, I. J. Nagrath and M. Gopal, Wiley Eastern Ltd.

Reference Books:

1. Modern Control Engineering, Ogata, PHI.

2. Control Systems Principles and Design, M.Gopal, McGrawHill.

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INTERNET OF THINGS AND APPLICATIONS

Course Objectives: The objectives of this course are

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices.

Course Outcomes: At the end of the course the student will be

- Able to understand the application areas of IOT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics.
- Able to design and implement IOT based systems

SYLLABUS

Introduction to Internet of Things: Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

IoT and M2M: Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG-NETCONF, YANG, SNMP NETOPEER.

Introduction to Python: Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages - JSON, XML, HTTP Lib, URL Lib, SMTP Lib.

IoT Physical Devices and Endpoints: Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

Controlling Hardware: Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors. Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful web API.

Text Books:

1.Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

2.Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

Reference Books:

1.Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan.

2.Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014 3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

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ARTIFICIAL NEURAL NETWORKS

Course Objectives: The objectives of this course are to

- Introduce a variety of Neural Network architectures
- Evaluate merits and demerits of learning models used by Artificial Neural Networks
- Describe the algorithms for training of Neural Networks
- Explain the effect of choice of parameters on training efficiency

Course outcomes: At the end of this course the student should be able to

- Describe major types of Neural Networks (L1)
- Classify Neural Networks based on type of architecture and learning method (L2)
- Apply Neural Networks to solve simple problems (L3)
- Analyze a problem and identify optimal Neural Network type for its solution (L4)
- Evaluate a problem description and predict optimal training algorithm and training parameters forits solution (L5)

SYLLABUS

Unit I

Introduction to Neural Networks: Architecture based classification of Neural Networks. Classification of Neural Networks based on learning methods. Activation functions and Loss functions. Factors to be considered for choice of type of Neural Network. Introduction to hardware requirements for implementation of Neural Networks.

Unit II

Rosenblatt's perceptron model. Rosenblatt's perceptron convergence theorem. Back Propagation Method. Back propagation learning algorithm for multilayer feed forward Neural Network. Factors affecting back propagation based training of a Neural Network.

Unit III

Radial basis function networks. Generalized regularization theory. Neural Network models with Hebbianlearning. Introduction to Hopfield networks. Recurrent Neural Network models. Universal approximation

theorem. Backpropagation through time. Real time recurrent learning. Long short term memory.

Unit IV

Convolutional Neural Networks. Variants of the basic convolution function. Convolution algorithms. Recursive Neural Networks. Greedy layer-wise pretraining. Transfer learning. Structured probabilistic models for deep learning. Convolutional boltzmann machines.

Unit V

Model based calculation of reward in Reinforcement learning. Markov decision process. Bellman's optimality criteria. Policy iteration. Value iteration. Q-learning. Model free Reinforcement learning. Deep reinforcement learning. Generative adversarial networks.

Text Book:

1. S.O.Haykin. Neural Networks & Learning Machines. 3rd Ed. Pearson. 2019

Reference Books:

1. S.J.Russell and P. Norvig. Artificial Intelligence: A Modern Approach. 3rd Ed. Pearson. 2016.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2018.
3. I.Goodfellow, Y.Bengio, A.Courville, F.Bach. Deep Learning (Adaptive Computation and MachineLearning series). MIT Press. 2016
4. S.O.Haykin. Neural Networks: A comprehensive foundation. 2nd Ed. Pearson. 1997.

ANNEXURE-III

HSS Electives

1. Industrial Management & Entrepreneurship
2. Organizational Behavior
3. Operations Research

INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives : The objectives of this course are

- To familiarize the students with the concepts of Management.
- To relate the concepts of Management with industrial organizations.
- To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.
- To set forth a basic framework for understanding Entrepreneurship.

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

- Understand the roles, skills and functions of management.
- Distinguish the different types of business organizations.
- Identify the factors involved in Production Operations Management.
- Diagnose organizational problems and take suitable decisions
- Establish good Human Resource Management practices.
- Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

SYLLABUS

Basic Concepts of Management: Management: Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management.

Forms of Business Organizations: Introduction,Types of Business organizations: Private Sector- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship: Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques, Stages in Project formulation; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Text Books:

1. Sharma, S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.
2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth), Himalayan Publishing House, 2018.

Reference Books:

1. Aryasri, A.R., Management Science, McGraw Hill Education (India Private Limited New Delhi 2014.
2. Sheela, P. and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

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ORGANIZATIONAL BEHAVIOUR

Course Objectives: The objectives of this course are

- To understand the basic concepts of organizational behaviour, its foundations and importance.
- To enable students to have a basic perspective of Motivation and Motivation theories.
- To acquaint the students about group behaviour in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

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

- Identifying fundamental aspects of organizational dynamics.
- Evaluate main theories of motivation and formulating suitable motivational strategies.
- Analyze the behaviour of individuals and groups in organizations.
- Understanding of Leadership theories and Leadership behaviour.
- Apply relevant theories, concepts to address important Organizational Behaviour questions.

SYLLABUS

Organizational Behaviour : Concept of Organisation - Concept of Organisational Behaviour - Nature of Organisational Behaviour - Role of Organisational behaviour - Disciplines contributing to Organisational Behaviour.

Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation : Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and Mc Gregor's Theory X and Theory Y.

Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication : Downward, Upward and Horizontal communication.

Organisational conflicts: Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Interorganisational conflict - Conflict management.

Organisational Change: Nature - Factors in Organisational change -Planned change: Process of planned change - Resistance to change: Factors in resistance to change - Overcoming resistance to change.

Text Books.

1. L.M.Prasad: Organisational Beaviour, Sultan Chand & Sons, New Delhi -110002
2. K. Aswathappa: Organisational Behaviour, Himalaya Publishing House, New Delhi

Reference Books.

1. Stephen Robbins: Organizational Behaviour, Pearsons Education, New Delhi.

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OPERATIONS RESEARCH

Course Objectives:

- Formulate a real world problem as a mathematical programming model.
- Provide knowledge of optimization techniques and approaches.
- Understand and study inventory problems.
- Know the network models.
- Put on knowledge in solving replacement problems and different queueing models

Course Outcomes:

- Learned to translate a real-world problem into a mathematical formulation.
- Formulate and Solve Transportation, Assignment and sequencing problems.
- Resolve inventory problems.
- Able to solve maximum flow and shortest path problems.
- Capable to solve replacement problems and analyze queueing models.

SYLLABUS

Introduction: Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution;

degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.

Sequencing: Sequencing of - *n* jobs through two machines; *n* jobs through three machines; *n* jobs through *m* machines; 2 jobs through *m* machines.

Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queueing models: Introduction; Single channel poisson arrivals; Exponential service times; Unrestricted queuewith infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

Text Books:

1. Hamdy A Taha, "Operations Research- An Introduction" by TAHA , Prentice Hall, 2009.
2. F.S. Hiller, G.J. Liberman,B. Nag and P.Basu "Introduction To Operations Research, Mc Graw Hill Education(India), 2012.
3. S.D.Sharma, "Operations Research", Kedarnadh Ramnadh & Co.,2017

Reference Books:

1. R. Pannerselvam, "Operations Research", PHI..
2. Richard Bronson, Schaum's Series," Operations Research", Mc Graw Hill
3. N.V.S.Raju, "Operations Research- Theory and Practice" BS publications.

4. V.K. Kapoor, "Operations Research" Sultan Chand & Sons.