EC- 5001 ELECTROMAGNETIC FIELD THEORY

Course Contents

Unit I

Review of vector calculus: orthogonal coordinate systems, gradient, divergence and curl. Laplacian operator for scalar and vectors. Vector integral and differential identities and theorems. Phasor representation of harmonic variation of scalar and vectors

Static electric fields, Columb's law, electric flux density and electric field intensity, permittivity, dielectric constant, field of distributed charges in free space, potential function, Laplace's and Poisson's equations, electric dipole, stored electric energy density. Boundary conditions at abrupt discontinuities between two media including conducting boundaries, surface charge distribution capacitance between two isolated conductors

Unit II

Solution of Laplace's equations in systems of dielectric and conducting boundaries, uniqueness theorem, two dimensional boundary condition problems, solution by symmetry, conformal transformation of functions, image theory etc. fields in parallel wire, parallel plane and coaxial systems.

Static currents and magnetic fields- flow of charge in conductive media, lossy conductive medium, current density, specific conductivity, mobility, explanation of Ohm's law employing mobility. Magnetic effects of current flow, Biot-Savart's law in vector form magnetic field intensity, magnetic flux, and permeability, closed loop currents, Ampere's circuital law in integral and differential vector form, magnetic vector potential and related equations. Problems related to straight wire toroidal and cylindrical solenoids, inductance.

Boundary conditions on magnetic field, equivalent surface currents for abrupt discontinuity of magnetic field.

Unit III

Time varying fields - Faraday's law in integral and differential forms, displacement current concept, Maxwell's equations in differential and integral forms, wave equations in source free region electric and magnetic stored energy density, continuity equation, Poynting vector theorem. Time harmonic fields, r.m.s. phasor representation of field vectors, Maxwell's equations for TH field, average energy density, complex Poynting vector, duality concept.

Helmholtz wave equation, general solution in free space in various coordinates, plane polarized wave in free space, properties of plane waves, wave front, power flow, stored energy density.

Unit IV

Circular and elliptic polarization, resolution in terms of linear polarized waves and vice- versa. Plane waves in lossy medium, low loss dielectric, good conducting and ionized media, complex permittivity, loss tangent, skin depth, transmission line analogy, boundary conditions at perfect conductor surface, surface current density Interference of two plane waves traveling at oblique directions.

Unit V

Reflection and refraction of plane waves at dielectric media and conducting Surfaces, Brewster's angle, total internal reflection, resultant fields and power flow in both media. Frequency dispersive propagation, phase velocity and group velocity. Magnetic vector potential for sources in free space, retarded potential, radiation principles, boundary condition at infinity

References:

1. Mathew N.O Sadiku: Elements of Electromagnetic, Oxford University Press
2. William H. Hayt: Engineering Electromagnetic, TMH.
3. John D. Kraus: Electromagnetics, Mc. Graw Hill.
4. Jordan Balmian: Electromagnetic wave and Radiating System, PHI.
5. David K. Cheng: Electromagnetic Fields and Wave, Addison Wesley.
6. Ramo, Whinnerry & VanDuzzer " Fields and waves in communication electronics ", Wiley 1984
7. Harrington RF, "Electromagnetic fields" Mc Graw Hill

EC- 5002 DIGITAL COMMUNICATION

Unit-I

Random variables

Cumulative distribution function, Probability density function, Mean, Variance and standard deviations of random variable, Gaussian distribution, Error function, Correlation and autocorrelation, Central-limit theorem, Error probability, Power Spectral density of digital data.

Unit-II

Digital conversion of Analog Signals

Sampling theorem, sampling of band pass signals, Pulse Amplitude Modulation (PAM), types of sampling (natural, flat-top), equalization, signal reconstruction and reconstruction filters, aliasing and anti-aliasing filter, Pulse Width Modulation (PWM), Pulse Position Modulation (PPM).

Digital transmission of Analog Signals

Quantization, quantization error, Pulse Code Modulation (PCM), companding, scrambling, TDM-PCM, Differential PCM, Delta modulation, Adaptive Delta modulation, vocoders.

Unit-III

Digital Transmission Techniques

Phase shift Keying (PSK)- Binary PSK, differential PSK, differentially encoded PSK, Quadrature PSK, M-ary PSK.Frquency Shift Keying (FSK)- Binary FSK (orthogonal and non-orthogonal), M-ary FSK.

Comparison of BPSK and BFSK, Quadrature Amplitude Shift Keying (QASK), Minimum Shift Keying (MSK).

Unit-IV

Other Digital Techniques

Pulse shaping to reduce inter channel and inter symbol interference- Duobinary encoding, Nyquist criterion and partial response signaling, Quadrature Partial Response (QPR) encoder decoder.

Regenerative Repeater- eye pattern, equalizers.

Optimum Reception of Digital Signals

Baseband signal receiver, probability of error, maximum likelihood detector, Bayes theorem, optimum receiver for both baseband and passband receiver- matched filter and correlator, probability of error calculation for BPSK and BFSK.

Unit-V

Information Theory

Source Coding: Introduction to information theory, uncertainty and information, average mutual information and entropy, source coding theorem, Huffman coding, Shannon-Fano-Elias coding, Channel Coding: Introduction, channel models, channel capacity, channel coding, information capacity theorem, Shannon limit.

References:

1. Taub and Schilling: Principles of Communication Systems, TMH.
2. Lathi: Modern Digital and Analog Communication Systems, Oxford University Press.
3. Simon Haykins: Communication Systems, John Wiley.
4. Ranjan Bose: Information Theory, Coding and Cryptography, TMH.
5. Das, Mallik, Chatterjee: Principles of Digital Communication, New Age International
6. Skylar and Ray: Digital Communications, Pearson Education.
7. Rao: Digital Communications, TMH.

List of Experiments:

1. Study of Sampling Process and Signal Reconstruction and Aliasing.
2. Study of PAM, PPM and PDM.
3. Study of PCM Transmitter and Receiver.
4. Time Division Multiplexing (TDM) and Demultiplexing.
5. Study of ASK, PSK and FSK Transmitter and Receiver.

EC- 5003 MICROPROCESSOR AND MICROCONTROLLER

Unit I

Architecture of 8086 Microprocessor

BIU and EU, register organization, pin diagram, memory organization, clock generator 8284, buffers and latches, 8288 bus controller, maximum and minimum modes.

Unit II

Assembly Language Programming of 8086

Instruction formats, addressing modes, instruction set, assembly language programming, ALP tools- editor, assembler, linker, locator, debugger, emulator.

8086 based multiprocessor systems

Interconnection topologies, coprocessors 8087 NDP, I/O processors 8089 IOP, bus arbitration and control, lightly and tightly coupled systems.

Unit III

Peripheral devices and their interfacing

Memory interfacing, Programmable input/output ports 8255, Programmable interval timer 8253, keyboard/ display controller 8279, CRT controller 8275, Programmable communication interface 8251 USART.

Unit IV

Interrupts of 8086

Interrupts and interrupt service routine, interrupt cycle, maskable and non-maskable interrupts, interrupt programming. Programmable interrupt controller 8259.

DMA in 8086

Basic DMA operation, modes of DMA transfer, DMA controller 8257.

Unit V

8051 Microcontroller

Features, architecture, Pin Diagram, memory organization, external memory interfacing, instruction syntax, data types, subroutines, addressing Modes, instruction set, ALP of 8051. Applications of 8051.

References:

1. Ray and Bhurchandi: Advanced microprocessors and peripherals, TMH.
2. Brey: The Intel Microprocessors, Architecture, Programming and Interfacing, Pearson Education.
3. Senthil Kumar: Microprocessors and interfacing, Oxford University press.
4. Bahadure: Microprocessors 8086 and Pentium family, PHI Learning.
5. Udayashankara and Mallikarjunaswamy: 8051 Microcontroller, TMH.
6. Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education
7. D. V. Hall: Microprocessors and Interfacing, TMH.

List of Experiments:

1. Assembly Language Programs of Microprocessor 8086.
2. Assembly Language Programs of Microcontroller 8051.
3. Assembly Language Programs for Interfacing Chips.

EC- 5004 COMMUNICATION NETWORKS AND TRANSMISSION LINES

Unit I

Characteristic Parameters of symmetrical and asymmetrical two port networks and their design Image impedance, iterative impedance, characteristic impedance, propagation coefficient, image transfer coefficient , iterative transfer coefficient, Lattice and Bridged T networks, reactive matching networks, matching techniques, insertion loss, symmetrical and asymmetrical attenuators and their design.

Unit II

Passive LC Filters

Analysis and design of Low pass, high pass, band pass and band elimination filters, m-derived filters, composite filters, Filter specifications, Butterworth approximation, Chebyshev approximation, elliptic function approximation, frequency transformation.

Unit III

Positive real function

LC, RL, RC, and RLC network synthesis, Foster and Cauer network, minimum positive real function, Brune's method, Bott-Duffin method, Synthesis-Coefficient.

Unit IV

Transmission line fundamentals : Lumped parameter equivalent, voltage and current on a transmission line, infinite line, characteristic impedance and propagation constant, waveform distortion, attenuation and phase equalizers, distortion-less line, loading, liner reflection on a line, reflection coefficient, input and transfer impedances, open circuit and short circuit line, reflection factors, reflection loss, insertion loss, T and π equivalents of a line, location of line fault, construction and design of two wire line and coaxial cable.

Unit V

Line at radio frequencies

Parameters of line and coaxial cable at radio frequencies, dissipation-less line, voltage and current on a dissipation-less line, standing waves, standing wave ratio, input impedance of open circuit and short circuit, power and impedance measurement on lines, eighth-wave, quarter-wave and half wave line, circle diagram, Smith chart, solution of problems using Smith chart, single and double stub matching .introduction to micro-strip lines and its analysis.

References:

1. Ryder: Networks and Transmission Lines, PHI Learning.
2. Valkenberg: Introduction to Modern Network synthesis, Wiley India.
3. Suresh: Electric Circuits and Networks, Pearson Education.
4. Raju: Electromagnetic field theory and Transmission Lines, Pearson Education.
5. Ganesan: Transmission Lines and Waveguides, TMH.
6. Rao: Electromagnetic Waves and Transmission Lines, PHI learning.

List of Experiments:

1. To set up the standing waves formation on a transmission line and observe their maxima and minima using frequency domain method.
2. To measure the characteristic impedance of transmission lines using frequency domain method and to differentiate between the matched and unmatched lines.
3. To measure the VSWR, reflection coefficient and return loss in a transmission line.
4. To measure the dielectric constant of insulator in the transmission line.
5. To measure the velocity of propagation and wavelength in the given transmission line.
6. To study the attenuation characteristics of signal along a transmission line and observe its variation with frequency. Also calculate the phase constant and propagation constant.
7. To study the effect of reactive loads on transmission lines.
8. To study the difference between lossy and loss less line.
9. To study the physical dimensions of transmission line and estimation of characteristic impedance.
10. To study behavior of infinite and short lines.
11. To study the operation of Balun transformer.
12. To study the loading of transmission lines and estimate the cut off frequency of a loaded line.
13. To study the use of coaxial lines as tuned circuits and delay lines.
14. To study the input and output impedance of any RF circuits and match it to 50/75 ohms.
15. Simulation of various filters

ELECTIVE-I EC- 5005 (1) COMPUTER SYSTEM ORGANIZATION

Unit-I

Computer Basics and CPU: Von Newman model, various subsystems, CPU, Memory, I/O, System Bus, CPU and Memory registers, Program Counter, Accumulator, Instruction register, Micro operations, Register Transfer Language, Instruction Fetch, decode and execution, data movement and manipulation, Instruction formats and addressing modes of basic computer.

Unit-II

Control Unit Organization: Hardwired control unit, Micro and nano programmed control unit, Control Memory, Address Sequencing, Micro Instruction formats, Micro program sequencer, Microprogramming, Arithmetic and Logic Unit: Arithmetic Processor, Addition, subtraction, multiplication and division, Floating point and decimal arithmetic and arithmetic units, design of arithmetic unit.

Unit-III

Input Output Organization: Modes of data transfer - program controlled, interrupt driven and direct memory access, Interrupt structures, I/O Interface, Asynchronous data transfer, I/O processor. Data transfer - Serial / parallel, synchronous/asynchronous, simplex/half duplex and full duplex.

Unit-IV

Memory organization: Memory Maps, Memory Hierarchy, Cache Memory -Organization and mappings. Associative memory. Virtual memory, Memory Management Hardware.

Unit-V

Multiprocessors: Pipeline and Vector processing, Instruction and arithmetic pipelines, Vector and array processors, Interconnection structure and inter-processor communication.

References:

1. Morris Mano: Computer System Architecture, PHI.
2. William Stallings: Computer Organization and Architecture, PHI
3. Carl Hamacher: Computer Organization, TMH
4. Tanenbaum: Structured Computer Organization, Pearson Education

ELECTIVE-I EC- 5005 (2) BIO MEDICAL INSTRUMENTATION

UNIT I - PHYSIOLOGY AND TRANSDUCERS

Cell and its structure - Resting and Action Potential - Nervous system: Functional organisation of the nervous system - Structure of nervous system, neurons - synapse -transmitters and neural communication - Cardiovascular system - respiratory system - Basic components of a biomedical system - Transducers - selection criteria - Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II - ELECTRO - PHYSIOLOGICAL MEASUREMENTS 9

Electrodes -Limb electrodes -floating electrodes - pregelled disposable electrodes - Micro, needleand surface electrodes - Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers -Isolation amplifier. ECG - EEG - EMG - ERG - Lead systems and recording methods - Typical waveforms.Electrical safety in medical environment: shock hazards - leakage current-Instruments for checkingsafety parameters of biomedical equipments

UNIT III - NON-ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound -Pulmonary function measurements - spirometer - Photo Plethysmography, Body Plethysmography - Blood Gas analysers : pH of blood -measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSRmeasurements .

UNIT IV - MEDICAL IMAGING

Radio graphic and fluoroscopic techniques - Computer tomography - MRI - Ultrasonography - Endoscopy - Thermography - Different types of biotelemetry systems and patient monitoring - Introduction to Biometric systems

UNIT V- ASSISTING AND THERAPEUTIC EQUIPMENTS

Pacemakers - Defibrillators - Ventilators - Nerve and muscle stimulators - Diathermy - Heart - Lung machine - Audio meters - Dialysers - Lithotripsy

TEXT BOOKS

1. R.S.Khandpur, ‘Hand Book of Bio-Medical instrumentation’, Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical Instrumentation and Measurements’, II edition, Pearson Education, 2002 / PHI.

REFERENCES

1. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, John Wiley & Sons, 1975.
3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, ‘Principles of Medical Electronics and Bio-medical Instrumentation’, Universities press (India) Ltd, Orient Longman ltd, 2000.

ELECTIVE-I EC- 5005 (3) INDUSTRIAL ELECTRONICS

Unit-I

Power Supplies

Power supply, rectifiers (half wave, full wave), performance parameters of power supplies, filters (capacitor, inductor, inductor-capacitor, pi filter), bleeder resistor, voltage multipliers . Regulated power supplies (series and shunt voltage regulators, fixed and adjustable voltage regulators, current regulator), switched regulator (SMPS), comparison of linear and switched power supply, switch mode converter (flyback, buck, boost, buk-boost, cuk converters).

Unit-II

Thyristors

Silicon controlled rectifies (SCR), constructional features, principle of operation, SCR terminology, turn-on methods, turn-off methods, triggereing methods of SCR circuits, types of commutation, comparison of thyristors and transistors, thermal characteristics of SCR, causes of damage to SCR, SCR overvoltage protection circuit, seies and parrel operation of sCRs, Line commutated converters (half wave rectifier with inductive and resistive load, single phase and three phase full wave rectifiers).

Unit-III

Other members of SCR family

Triacs, Diacs, Quadracs, recovery characteristics, fast recovery diodes, power diodes, power transistor, power MOSFET, Insulated gate bipolar transistor (IGBT), loss of power in semiconductor devices, comparison between power MOSFET, power transistor and power IGBT.

Unit-IV

Applications of OP-AMP

Basics of OP-AMP, relaxation oscillator, window comparator, Op-comp as rectangular to triangular pulse converter and vice- versa, Wien bridge oscillator, function generator, frequency response of OP-AMP, simplified circuit diagram of OP-AMP, power supplies using OP-AMP, filters (low-pass, high pass) using OP-AMP.

Unit-V

Programmable Logic Controller (PLC)

Functions, applications, advantages and disadvantages of PLC over conventional relay controllers, comparison of PLC with process control computer system, factors to be considered in selecting PLC, functional block diagram of PLC, microprocessor in PLC, memory, input and output modules (interface cards), sequence of operations in a PLC, status of PLC, event driven device, ladder logic language, simple process control applications of PLC, Programming examples.

References:

1. Bishwanath Paul: Industrial Electronics and control, PHI Learning.
2. Rashid: Power Electronics- Circuits, devices and applications, Pearson Education.
3. Singh and Khanchandani: Power Electronics, TMH
4. Bhimbra: Power Electronics, Khanna Publishers.
5. Moorthi: Power Electronics, Oxford University Press.
6. Webb: Programmable Logic Controllers- Principles and Applications, PHI Learning.
7. Petruzulla: Programmable Logic Controllers, TMH.