L T P
(3 1 0)

EE 742: Communication Engineering

Full marks: Theory=100
Sessional=75

1. **Introduction to communication issues:**

History of communication, Issues of noise in communication, Sources and characteristics of different noise, thermal and shot noise, concept of white Gaussian noise. Noise temperature, noise bandwidth and noise figure.

2. **Amplitude Modulation :**

Concept and need of Modulation, Generation and detection of Amplitude Modulation- AM-DSBFC, DSBSC, SSB, Square Law modulation, switching modulator, square law demodulator, Envelop detector, Balance Modulator, Ring Modulator signals, Power spectra of AM.

3. **Angle Modulation :**

Generation and detection of Frequency and Phase Modulation – NBFM, WBFM, Transmission bandwidth , Indirect and direct method for FM generation, Frequency discrimination, PLL demodulation, Super heterodyne receivers, Frequency Division Multiplexing.

6. **Pulse Modulation:**

PAM, PPM, PWM systems, Sample and hold circuit, Concept of PCM- generation and reconstruction, basic coding and quantization, quantization noise, non uniform quantization and compounding, signal to quantizing noise power ratio, Signaling Format, Time Division Multiplexing. Pulse shaping and Inter Symbol Interference (ISI).

4. **Random signal theory :**

Random variable – cumulative distribution function, probability distribution function, statistical averages, standard deviation, Gaussian and Rayleigh PDF. Random processes – ensemble averages and correlation, stationary and ergodic process.

6. **Performance of communication system in presence of noise:**

Signal to noise ratio, Noise in base band communication system and signal to noise ratio, Noise in Amplitude Modulation system and signal to noise ratio, Noise in Frequency and Phase modulation systems and signal to noise ratio.

7. **Digital Communication:**

Generation and detection of ASK, PSK, FSK, DPSK and QPSK.

Books:

1. Modern Digital and Analog Communication System, B.P.Lathi, Oxford University press, India
2. Communication System, Simon Haykins, John Wiley & Sons.
3. Communication System, V. Chandrasekar, Oxford University press, India
4. Communication Engineering, Sanjay Sharma, S.K.Kataria & Sons

EE-743: Embedded System L T P (3 1 0)

Full marks: Theory = 100

Sessional = 50(lab)+25 CT) =75

Introduction: Introduction to Programmable device, concept of common BUS, operation of a programmable device, design and realization of a simple programmable device (Microcontroller/Microprocessor) with simple instructions like – data transfer, ALU operations, port operation etc. History of Microcontroller and Microprocessor. Difference between Microcontroller and Microprocessor. MPU of different categories- such as Microcontroller-8051, AVR etc, their specific features, advantages.

Microcontroller 8051: Introduction. MCS-51 Architecture. Registers, I/O Ports. Memory organization. Hardware interrupts, Timer and Serial input/out.

Assembly and C Programming of Microcontroller 8051: Instructions- Addressing modes, Arithmetical. Logical. Jumps. Loops and Call etc. Interrupts, Timers/ Counters and Serial Communications.

Application of MCS-51: Interfacing LCD., Key board, principle DAC and ADC - Multi-channel programmable parallel data BUS ADC, Multi-channel programmable SPI base ADC. Basic features of an embedded system used for real-time practical application. Data- logger. Development of instrumentation system for measurement of - light intensity, temperature, pressure, flow, frequency, pulse width, voltage, angular speed etc. Generation of PWM wave. PID controller, analytical instruments such as Sequential control and interlock control.

Introduction to AVR ATmega 8/16/32 – basic port operation, configuration in-built ADC for sampling analog signal, serial data communication thorough TxD and RxD and fundamental of timer operations.

Reference:

1. Microcontrollers : Theory and Applications – by A V Deshmukh
2. The 8051 Microcontroller and Embedded system using assembly and C . – Md Ali Mazidi, Rolin D. Mc-Kindly and Janice Gillistie.
3. The AVR Microcontroller and Embedded using assembly and C. - Md Ali Mazidi, Sarmad Naimi and Sepehr Naimi

EE 741: ELECTRIC POWER SYSTEM-III

L T P (3 1 0)
Full Marks: Theory =100
Sessional=75
Time=3 Hrs.

1. Representation of power system components

Per Unit Representation of power system elements such as : Synchronous machine, transformers with tap setting, transmission line etc, Single line diagram.

2. Network matrix:

Primitive network, bus incidence matrix, formation of Y-bus by singular transformation , networks with mutually coupled elements, formation of Z-bus by matrix inversion , formation of Z-bus using the building algorithm – addition of a tree branch p to reference bus , addition of a link between buses p and q , addition of a link between bus p and reference bus .

3. Symmetrical components and unsymmetrical fault calculations:

Fortesque's theorem. Symmetrical components of an unbalanced 3- phase system: average power in terms of symmetrical components, sequence impedances, fault calculations, graphical method for determining sequence components, network equations. LG, LL, LLG faults. Effect of fault impedance on fault current. Sequence networks.

4. Load flow analysis :

Introduction , classification of buses , representation of transformers , Gauss Seidel iterative method using Ybus , N-R iterative method using Y-bus. Calculation of line flows.

5. Power system stability:

Introduction. Dynamics of synchronous machine, swing equation. Power- angle curve. Steady- state and transient Stabilities. Equal area criterion. Calculation of power – angle curves for fault and post – fault conditions for various types of fault; effect of reclosing. Numerical solution of swing equation. Dynamic stability. Factors affecting stability.

6. Automatic load frequency and voltage control.

Concept of load frequency control (LFC), LFC model for single/multi area systems, tie-line control in interconnected system (multi area system), Concept of voltage and reactive power control.

REFERENCES:

1. Electrical Power—S.L.Uppal.
2. Electrical Power System---C.L.Wadha.
3. Computer Methods in Power System Analysis – Stagg, El-abiad McGraw-Hill
4. Power system operation and Control – P S Murty Tata McGRAW-Hill
5. Computer Techniques in Power System Analysis: M A Pai, Tata McGRAW-Hill

EE 744.1: Advance Control System (Elective-I).

L T P
(3 1 0)
Theory marks = 100
Sessional= 75

1. State Space Analysis

State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.
Controllability and Observability: Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability form Jordan canonical form and other canonical forms.

2. Describing Function Analysis

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.
Phase-Plane Analysis: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

3. Stability Analysis

Stability in the sense of Lyapunov., Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.
Modal Control: Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

4. **Calculus of Variations**

Minimization of functionals of single function, Constrained minimization. Minimum principle. Control variable inequality constraints. Control and state variable inequality constraints. Euler Lagrangine Equation.

5. **Optimal Control**:

Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators.

6. Discrete time systems

Introduction to discrete – time systems; Z- transform, inverse Z- transformation; solving difference equation by the Z-transform method; pulse- transfer function; stability analysis in the Z- plane.

Suggested Readings

1. M. Gopal, **Modern Control System Theory**, New Age International.
2. K. Ogata, **Modern Control Engineering**, PHI.
3. I.J. Nagarath, M.Gopal, **Control Systems Engineering**, NAI.
4. Stainslaw H. Zak, **Systems and Control**, Oxford Press.

EE744.3: INSTRUMENTATION (ELECTIVE-I)

L T P
(3 1 0)
Full marks: Theory =100
Sessional =75

1 .**Introduction:**

Generalized approach to measuring systems. Function descriptions. Transducers- Active and passive, primary and secondary transducers. Input- output configuration of measuring instruments and Instrument systems.

2**. Generalized performance characteristics of instruments:**

Static characteristics- Accuracy, Precision, Errors, Uncertainty and Bias. Static sensitivity. Linearity.

3. **Sensors :**

Resistive pots, Strain gauges, LVDTs, capacitive transducers, piezoelectric transducers, Hall Effect transducers. Digital shaft position encoder, Ultrasonic transducers, Seismic sensors.

4. **Process Instrument**:

Measurement of temperature (RTD, thermistors, thermocouples, pyrometers). Measurement of Force and Pressure (Bellows, Bourdon tubes, Load cells, Diaphragm etc). Level measurement.

5**. Servo Components:**

Synchros, DC and AC servomotors, Tachogenerators, Stepper Motor.

6**. Signal conditioning**:

D.C. And a. c. signal conditioning circuits. Operational amplifiers. Instrumentation amplifier. Amplitude Modulation and Demodulation. Bridge circuits. Analog to digital (A/D) and Digital to Analog (D/A) converters.

7. **Data transmission and Telemetry**:

Methods of data transmission. D.C. Telemetry systems. A.C. telemetry systems. Modulation- Amplitude modulation (A.M), Frequency modulation (F.M), Phase modulation, pulse amplitude modulation (PAM), Pulse duration modulation (PDM).

8. **Introduction to the optical, Ultrasonic, radio isotopes and laser based Instrumentation systems.**

Books / References:

1) Measurement System Application And Design: Doeblin.E.O. (Tata McGraw)

2) Electrical measurements and measuring instruments: swahney.A.K (Dhanpat Rai)

3) Instrumentation, Measurement and Analysis: Nakra, Choudhury (Tata McGraw)

EE 744.2:Optoelectronics (Elective-I)

L T P (3 1 0)
Full marks: Theory = 100
Sessional = 75

Optical fiber wave guides-Theory of Dielectric slab waveguides-Symmetric and Asymmetric slab wave guide, Channel waveguide, Review of ray theory-Electromagnetic mode theory-Phase and group velocity-Modes-guided, radiative and leaky modes-'V' number-cut off wave length-Step index and graded index fibers-Parameters of optical fiber-problems. Signal degradation in fibers-Attenuation-Absorption loss-Linear and nonlinear scattering loss-Fiber bend loss-Dispersion mechanisms-Intramodal and intermodal dispersion-Expressions-modal noise-overall dispersion in single mode/multimode fibers-problems-mode coupling.

Optical sources-Light emitting diodes- P N junction characteristics- Direct and Indirect band gap materials- Spontaneous emission- Carrier concentration variation in n+p junction- carrier life time-Diffusion coefficient- Diffusion length- Injection efficiency- internal Quantum efficiency-Power internally generated- Overall efficiency of LED- problems- Heterojunction LEDs – Advantages- LED modulation- Electrical and Optical Bandwidth- LED structures-ELEDs and SLEDs-LED characteristics-Effect of temperature- LED Drive Circuits.
LASER diodes- Spontaneous Vs Stimulated emission-Einstein's relation-population inversion-cavity resonance and threshold gain-Laser modes-stimulated emission in PN junction-Rate equation-condition for lasing-Laser diode characteristics-Modulation-frequency chirp Heterojunction LASER-LASER structures-LED Vs LASER diodes.

Optical Detectors and Fiber optic link, classification of detectors-Photodiodes-PN junction photo diode-PIN photodiode- response and noise- APDs –Advantages of APD- APD Bandwidth and noise-Phototransistor-parameters of phototransistor-problems-Detector performance parameters-noises- NEP Power launching and coupling- source to fiber coupling-joints- fiber to detector coupling- losses-fiber splicers, connectors and couplers-types-Fiber optic link-System considerations-link power budget-rise time budget-Link Design

Electro Optic Effects: Birefringence phenomenon EO Retardation, EO Amplitude and Phase Modulator, Electro optic Intensity Modulators, Beam deflection, Acousto-optics, A-O Modulators, Integrated optic spectrum analyzer, Non linear optics second harmonic generation, Parametric amplification. Advanced system technology-Optical amplifiers-Raman and Erbium doped optical amplifiers-noises-Wave length Division Multiplexing (WDM) and components-Optical network-wave length routed networks.

Optical Fiber Sensors: Fiber optic sensors-classification, Multimode fiber Sensors-Displacement, pressure, stress, strain. Intensity modulated sensors, Active multimode FO sensors, Micro-bend optical fiber sensor, Current sensors, Magnetic sensors, Single mode FO sensors, Phase modulated, Polarization modulated, Fiber Optic Gyroscope. Fiber bragg gratings for strain and temperature sensors-displacement sensor-optical computing concepts-optical logic gates.

Text Books

1. Semiconductor Optoelectronic Devices, P. Bhattacharya, PHI.
2. Optical Fiber Communications, G. Keiser, McGraw-Hill Inc.
3. Optical Fiber Communication: Principles and Practice, J. M. Senior, PHI.
4. Optoelectronics devices and system-Dr. S. C. Gupta-PHI
5. Optical communication Systems-John Gower-PHI
6. Optical fiber Communication Systems-Principles and practice-John M. senior-Pearson

Elective - 2

EE 745.3: Illumination Engineering (Elective)

Books:

1) Cotton.H, Principles of Illumination, Chapman & Hall.
2) Boast. W.S., Illumination Engineering, McGraw-Hill.
3) IES Lighting Handbook, Illumination Engineering Society, New York.

EE 842: ELECTRIC POWER SYSTEM –IV

BOOKS

1. Wood and Wollenburg: Power generation, operation and control—John Wiley and sons.
2. Electrical Power—S.L.Uppal.
3. Power system operation and Control – P S Murty Tata McGRAW-Hill

Electric Energy System Theory: An Introduction- Olle L. Elgerd Tata McGRAW-Hill

Elective - 2

EE 745.3: Illumination Engineering (Elective)

3-1-0

Max Marks: 100
Sessional: 75

1) **Radiation:-** Wavelength, frequency & velocity. The radiation spectrum. Radiations from black bodies & other sources.

2) **Entities in the illumination system and their units:-** Luminous sources, illumination, intensity, brightness, other terms and units. The inverse square law. The cosine law. Solid angle relation ship. Luminosity, relationship between brightness & luminosity for a perfectly diffusing source, illumination standards.

3) **The eye & vision:-** The structure of the eye, accommodation, aberration of the eye, the rods & cones, visual acuity, glare, color & color response of the eye.

4) **Light Sources & Their Characteristics:-** Day light incandescent, electric discharge(low & high pressure), fluorescent, are amps and laser beams, color rendering, wiring, switching & control circuits. Starters & ballast.

5) **Light Control:-** Reflection & reflection factor, absorption, transmission & transmission factor. Control of light by luminaries.

6) **Illumination & measurement:-** Illumination from point sources, light units in a row, area illumination, polar curves. Linear & surface sources, flat linear source, flat-strip of short length. Illumination of a vertical source. Radiant energy detectors, PV cell, Photo-tubes, Photometry, Electro-photometry, Photo cells, Spectro-photometer, Colorimeters.

7) **General Illumination & Design calculation:-** Interior lighting of industrial, residential & commercial buildings. Effective utilizations of daylight. Daylight factor, Outdoor lighting, Street, rail/shipyards, airports, sports area. Lighting design for signaling, advertising & security.

Books:

1) Cotton.H, Principles of Illumination, Chapman & Hall.
2) Boast. W.S., Illumination Engineering, McGraw-Hill.
3) IES Lighting Handbook, Illumination Engineering Society, New York.

EE 745.1: Renewable Energy (Elective-II)

3-1-0

Max Marks: 100
Sessional: 75

1) Introduction to Non conventional energy sources:-
Importance, primary & secondary energy sources, limitations to primary sources, various sources of non-conventional energy, renewable energy.

2) Solar Energy:-
Solar radiation, solar radiation angles, local solar time, solar collector-flat plate collector & solar concentrator, solar heater-water heater & air heater, solar cooker, solar distillation, solar energy storage- sensible heat storage & latent heat storage.

3) Photovoltaic Energy Conversion:-
Photovoltaic effect, equivalent circuit & V-I characteristics of PV cell, types of solar cell & their characteristics, effect of temperature, light intensity, cell-area & series resistance on PV cell, solar cell array & module and their configurations, specifications of PV module, PV system & their components, isolated & grid connected PV systems.

4) Wind Energy:-
Wind energy conversion, wind turbine rotor -classification, characteristics & analysis of ideal wind turbine rotor, power co-efficient, air foils, lift & drag forces, blade shape for ideal rotor, generalized rotor design procedure , wind turbine_ subsystems, components, design, power curve prediction, electrical aspects of wind turbine, grid connected wind turbine, wind farms, site selection.

5) Fuel Cell:-
Introduction, energy conversion principles, types of fuel cell, components of a fuel cell, polarization.

6) Energy from bio-mass:-
Introduction, Bio-mass conversion technologies, bio-gas generations, classifications of bio-gas plants, selection of site for bio-gas plant, utilization of bio-gas, thermal gasification of bio-mass.

7) Geo thermal Energy:-
Sources and use of geo-thermal energy, geo-thermal power plants, applications.

8) Energy from the ocean:-
Tidal power, components of tidal power plants, generation of tidal power, estimation of energy & power, ocean thermal energy conversion (OTEC)_ introduction, types, plants & their specifications.

9) Magneto Hydro Dynamic Generation:-

Principles of MHD generation, MHD generator, equivalent circuits, MHD system.

10) Combined Operation utilizing more than one source, composite systems.

Books:

1) G.D. Rai, Non conventional energy sources, Khanna publishers.
2) Thomas Markvart, Solar Electricity, John Willy & Sons.
3) A.C.Baker, Tidal Power, Peter Peargrenus Ltd.
4) G.N.Tiwari, Solar Energy_Fundamentals, design, modeling & application, Narosa Publishing House.

EE 745.2: Utilization & Conservation of Electrical Energy (Elective-II)

(3-1-0)

Max Marks: 100
Sessional: 75

1) Electric Heating:-

Advantages, Classification, Resistance Heating, Furnaces, Requirements and Design of heating elements, Temperature control, Electric arc furnaces, Direct & Indirect, Construction & Operation, Electrodes & Power Supply, High Frequency Heating, Induction Heating, Working principle, Power & High frequency Heating, Choice of Frequency, Core type & Coreless Furnaces, Skin Effect & Pinch effect, High Frequency Supply, Advantages & Disadvantages, Dielectric Heating, Working principle, Choice of Voltage and Frequency, Advantages & Applications.

2) Electric Welding:-

Classifications, Resistance Welding:: Spot, Butt, Seam. Arc welding:: types, electrode used, power sources and control circuits. Atomic hydrogen welding. Modern development.

3) Electric traction:-

Advantages. Systems of electric traction. Choice of system voltage and frequency. The Indian scenario. Types of train services. Train movements and energy consumption.speed-time, distance-time and energy consumption curves.Tractive effort, Adhesion, Train resistance. Power supply arrangements. Substation equipment. D.C AND A.C. traction motors, their disposition and operation on tram cars, motor coaches and locomotives. Control systems; Rheostatic, field control and series-parallel using shunt and bridge transition methods. Multiple unit control. Metadyne control. Controllers for dc & ac traction motors. Tram Cars, Motor coaches, & Trolly Buses. Auxiliary Electrical Equipments for Tram cars, Motor Coaches & Locomotives. Braking:: mechanical, vacuum & electrical.

1) Energy Storage:-

Size & Duration of storage. Modes of energy storage::mechanical,
electrical, magnetic, thermal & chemical. Comparison of the different systems.

2) Electrical Losses & Energy Conversion:-

Electrical transmission, distribution & utilization losses. Classification. Reduction of losses. Benefits of electrical energy conservation. Energy conservation in lighting, electric furnaces, electric drive, traction systems. Use of energy –efficient equipment.

6) Electrical Energy Audit:-

Introduction, benefits, procedure for energy audit. Instruments for energy audit. Methodology. Case study.

Books:-

1) Tripathy, S.C ; Electrical Energy Utilization & Conservation, TMG
2) Suryanarayan, N.V. ; Utilization of Electric power ; Wiley Eastern Ltd.
3) Pratab, H.; Utilization of Electrical Energy; Dhanpat Rai & Sons.