EE 542 : Control System – I(EE/I

L T P
3 - 1 - 3
Max. Marks = 100
Sessional = 100

1. **Elementary Concepts: of control systems**:

Open loop and closed loop systems. Examples of modern control systems, Definition of linear, non-linear, time-invariant and time variant, continuous and discrete control system.

2. **Models of physical systems:**

Formulation of differential equations for dynamic systems. Mechanical and Electrical systems. Transfer functions of a linear system. Block diagrams and reduction techniques, Signal flow graphs. Mason's formula. Standard test signals - step, ramp, parabolic and impulse. Impulse response.

3. **Introduction to control system components:**

error detectors, servo motors, techno-generators and servo amplifiers. Determination of transfer functions.

4. **Time domain analysis:**

Poles, Zeros and characteristic equations, Relation between S-plane root locations and transient response. Performance specifications in time domain such as overshot, rise time, settling time and steady state error. Transient response of second order systems. Derivative and Integral Control and their effect on the performance of the 2^{nd} order system. System types and error constants. Generalized error co-efficients. Transient response of higher order systems (out line only). Roth's stability criterion, scopes and limitations of Routh's criterion.

5. The root locus technique:

Introduction, Rule for construction. System analysis and design (out line only) using root locus.

6. Frequency Domain analysis:

Logarithmic plots, polar plots, log-magnitude Vs phase plots.

Nyquist stability criterion, Stability analysis. Relative stability. Close loop frequency response. Experimental determination of transfer functions. M and N circle.

Books:

1. Automatic Control System – Kuo
2. Modern Control Engineering – Ogata
3. Control System Engineering - Nagrath and Gopal
4. Control System Components – Gibson and Teylor

EE 541: DIGITAL SYSTEMS (EE/IE)

L T P
3 1 3
Max. Marks = 100
Sessional Marks = 50
Laboratory Marks = 50

1. **Number system**:

   Number base conversion, Binary numbers, octal and hexadecimal numbers, complements, signed binary numbers, Binary codes, floating point numbers and arithmetic.

2. **Boolean algebra and logic gates:**

   Basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms-SOP & POS. Logical operations, truth tables, logic gates, logic levels and pulse waveforms, pulsed operation.

3. **Simplification of Boolean functions:**

   The map method- the Karnaugh map, minimal SOP & POS, Don't care conditions, multiple output minimization, tabular method, Quine-Mcclusky method, determination and selection of prime implicants.

4. **Combinational Logic:**

   (Logic synthesis): Introduction, universal property of NAND and NOR gates, AND-OR networks, NAND & NOR networks, EX-OR networks, design and analysis of combinational logic.

5. **Functions of combinational logic:**

   Adders & substractors, parallel binary adders, magnitude comparator, code conversion, decoders & encoders, Multiplexer & demultiplexers, parity generators & checkers. Read only memories PLA & PAL

6. **Synchronous sequential logic: Introduction:**

   S-R, J-k, D and T Flip Flops, Excitation table, Triggering of F/Fs & Latches, One shot Astable multivibrator.

7. **Registers, Counters and Memory Units:**

   Registers: - Shift – Registers, Ripple Counters, Synchronous Counters. Ring Counters, Timing Sequences, Design Procedure, Random Access Memory, Memory Decoding.

8. **Digital integrated Circuit:**

   Introduction, special characteristics (Fan-Out, Power dissipation, Propagation delay, figure of merit, noise level) Introduction to TTL, ECL, MOS, and CMOS circuit.

Books:

1. Digital Design – M. Marris Mano.
2. Logic Design Theory – NN Biswas
3. Digital Fundamental – TL Floyd
4. Digital Electronics- R.P.Jain.

EE 545: Electrical Machine - II

L T P
3 1 0
Max. marks = 100
Sessional = 50

1. **Synchronous Machines:**

Construction and principles of operation of synchronous generators and motors. Ventilation and cooling, Armature windings, winding factors, emf equation. Armature reaction, leakage reactance, synchronous reactance, and impendence of non-salient pole machines. Short circuit and open circuit tests, short circuit ratio, M M F in salient and non-salient pole machines. Calculation of regulation by synchronous impedance method. MMF method and ASA method.

Introduction to two-reactance theory, locus diagram of synchronous impedance, slip test, damper winding and oscillation of synchronous machines, Synchronization, power angle diagram and synchronizing power. Determination of sub-transient and transient react races and time constants of synchronous machine by different methods. Determination of sequence impedances of synchronous machine. Parallel operation.
Synchronous motor: Phasor diagram, effect of varying excitation, effect of load variation, V-curve, O-curve, power angle diagram and stability, Hunting, Two-reaction theory of salient-pole motor, Starting. Use as synchronous phase modifiers.

2. A.C. commutator motors:

Construction and functions of the commutator.
3-phase commutator motor: Effects of voltage injection into the rotor circuit of a polyphase induction motor. Construction and operation of the Schrage motor. Effects of brush movement.
1-phase commutator motors: Universal and repulsion motors: Construction and principle of operation, Starting methods, Speed control, Improvement of commutation and power-factor by compensation.

3. Single phase induction motors:

Construction, Rotating and cross field theories, Equivalent circuit, Speed-torque characteristic, Starting methods.

4. Reluctance motors:

Construction and principle of operation, Synchronous and sub-synchronous operation, Effects of frequency and rotor resistance, Types of reluctance motor, Speed-torque characteristic.

5. Stepper motor:

Construction and principle of operation, Types, Characteristics, Selection and Application.

6. Servomotors:

Construction and principle of operation of AC and DC servomotors. Types, Damping in AC servomotors, Application.

REFERENCES:

1. Theory of Alternating Current Machinery: Langsdorff, A.S. MC-Graw Hill.
2. Electrical Machines: Nagrath I.J. and Kothari D.P. Tata MC-Graw Hill
3. Electrical Machines: Mukherjee P.K. and Chakravarty S. Dhanoat Rai.
4. Advanced Electrical Technology: Cotton H.
5. The Performance and Design of AC Commutator Machines: Taylor E.O. Wheeler.
6. Fractional and Sub-fractional H.P. Electric Motors: Veinott G.C. and Martin J.E. MC-Graw Hill

EE 544: ELECTRIC POWER SYSTEM – I

L T P
3 1 0
Theory Marks =100
Sessional Marks = 50

1. **General Introduction**:

Introduction to power system, Single line diagram.

2. **Distribution:**

Different systems and their comparison based on relative copper efficiencies, Concentrated and distributed loads in radial distributors fed at one and both ends. Ring mains. Stepped distributors, sub mains, feeders. Design of distributors, feeder and distribution substation.

3. **Line constants**:

Resistance – Conductor materials. ACSR expanded ACSR, hollow and bundle Conductors. Use of standard wire tables.

Inductance- Inductance of solid cylindrical conductor, composite conductor. Concept of G.M.D. Inductance of single conductor with ground return, 2-conductor single phase line, inductance of three phase single circuit and double circuit lines with symmetrical and unsymmetrical spacing. Skin effect and proximity effect. Bundle conductors. Internal impedance of conductor. Bessel real and Bessel imaginary.

Capacitance- Capacitance of isolated conductor, 2-conductor single phase line, three phase single circuit and double circuit lines with symmetrical and unsymmetrical spacing. Method of image and effect of ground. Charging current.

4. **Performance of Transmission Lines**:

Performance of short- length and medium- length lines:

Nominal- T and Nominal- pi representation. Performance of long transmission lines. Interpretation of the long- line equations. SIL. Ferranti effect. Generalized line constants and their application. Receiving- end, sending- end and universal Power-circle diagrams. Calculation of synchronous phase modifier capacity (SPM).line regulation. Maximum power limits. Efficiency of transmission line.

5. Mechanical design:

Supporting structure for overhead lines. Towers(A,B,C,D and DE types), Disposition of conductors, spacing between conductors, length of span, calculation of sag and tension for equal and unequal suspension levels. Stringing chart, sag template, vibration and vibration damper.

6. Insulators:

Different types of insulators. Leakage path, wet flashover and dry flashover distances, potential distribution over a string of suspension insulators, Methods of equalizing the potential. String efficiency.

7. Cables:

Insulating materials. Construction of single core and multi-core cables, Armouring, laying and jointing.
H.V cables: pressure cables- oil filled and gas filled cables. Stress and capacitance of single core cable, most economical size of conductor. Capacitance and inter-sheath grading. Dielectric stress in bushing insulator. Capacitance and stress in 3 core cable, sheath effects, sheath current, insulation resistance, breakdown voltage and mechanism of breakdown. Thermal characteristics of cables.

8. Corona:

Corona discharge, disruptive corona voltage and visual critical voltage, factors effecting corona, corona power loss, empirical laws, line design based on corona, advantages and disadvantages of corona, radio interference, inductive interference between power and communication lines

REFERENCES:

1. Electrical Power—S.L.Uppal.
2. Electrical Power System---C.L.Wadha.
3. Electrical Power System's design—M.V. Despande.
4. Switchgear principles—P.H.J.Crane.
5. Switchgear and Protection—S.S. Rao
6. Switchgear and Protection-- M.V. Despande.

EE 543: POWER ELECTRONICS (EE/IE)

L T P
3 1 3
Theory Marks= 100
Sessional Marks=50
Lab=50
Time= 3 hours.

1. Operational Amplifier:

Features of an ideal, OP- AMP and typical applications, definitions of important terms including voltage and current off – sets, common- mode range, common – mode rejection ratio, power supply rejection ratio, slew rate, Zener diode voltage reference and voltage/ current sources in OP- AMP.

2. **Regulated D.C. Power supplies**:

Requirements and principles Constant voltage and current regulators, use of ICs, Line regulation, introduction to switching regulators.

3. **Semiconductor Power Devices:**

Introduction, power diodes, power transistors and SCRs and their operations, GTOs, Triacs and other types of thyristors, their characteristics, ratings, mounting and cooling. Series and parallel connections of SCRs. Triggering and control.

4. **Converter Operation with SCRs:**

Single phase half- wave, full- wave and bridge circuits, three- phase half wave and bridge circuits, six- phase with interphase transformer, fully controlled and half- controlled circuits. Effects of load and source inductance. Dual converter and cycloconverter operating modes. Line commuted inverters, firing and control circuits for different operations.

5. **Forward commutation and Forced**:

Commutated inverters: Forced commutation circuits, parallel, series and bridge (single-phase and three- phase) inverters, McMurray and McMurray- Bedford inverter circuits, Voltage and current source inverters. Output voltage control harmonics eliminations. Firing circuits for inverters.

6. **Choppers:**

Principles of operation, classification, DC, AC, and multi- quadrant choppers, Morgan's, Jones, and Mazda's choppers. Application.

7. **Applications of SCRs**:

SCR battery chargers, replacement of electromechanical devices by SCRs.

References:

1. Gray, P.E.&c.L.Scurle: Electronic Principles- Wiley Eastern.
2. Grabane, A.B.:Analog integrated Circuit Degign- Van Nortrand.
3. Ramamoorthy, m.: An Introduction to Thyristors and their Applications- East West Press.
4. Rashid, M.H. Power Electronics, Circuits, Devices and Applications- Prentice Hall of India.
5. Sen, P.C.: Power Electronics- TMH.
6. Dubey et al; Thyristorised Power Controllers- Wiley Eastern..

IE 552: Electronic Instrumentation

L T P
3 1 0
Max. Marks=100
Sessional = 50

Basic principle of analog electronic instruments: peak, rms and average-reading type voltmeter, Q-meter and distortion meter, vector impedance meter, vector voltmeter..

Operational Amplifiers: Characteristics & Circuit Configurations. Instrumentation amplifiers and their applications.

Active filters and their design considerations-: low pass, band pass and high pass filters.

Function generators: square wave, triangular, saw tooth type pulse and square wave generators. Sweep frequency generator.

Analogue and digital data acquisition systems: Interfacing transducers to electronic control and measuring systems.DC and AC signal conditioning circuit, Analog to Digital (A/D) and Digital to Analog (D/A) converters.

PLL, voltage to frequency and frequency to voltage converters: Lock-in amplifier and its application, digital frequency meter, wave and spectrum analyzers harmonic distortion analyzer, heterodyne harmonic analyzer.

Strip-chart recorder, x-y recorder.

Books:

1. Electrical and Electronic Instrumentation: Swahney, A.K.
2. Modern Electronic Instrumentation and Measurement Techniques: Helfric AD and Cooper WD, PHI, 1992
3. Instrumentation, Measurement and Feedback :Jones BE,
4. Op-Amp and Integrated Ckts:Gayakwad RA,PHI,N.Delhi
5. Electronic Instrumentation : Kalsi, TMH

IE 551: Instrumentation Systems Components – I

L T P
(3 1 3)
Max. Marks = 100
Sessional Marks= 50
Lab Marks= 50

Transducers: classification. Resistance transducers. Resistance potentiometers. RTD and thermistors. Strain gauges and their application in pressure, force and torque measurements. Load Cells. Hot wire anemometers and associated circuits.

Inductive transducers: Types of inductance transducers and their principles of operation. LVDT and phase sensitive detectors. Variable reluctance type transducers. Push-pull arrangement and reduction of non-linearity. Associated circuits.

Capacitive transducers:Air gap and dielectric type. Capacitance Bridge. Capacitance microphone and associated circuits.

Piezoelectric transducers-: principle of operation, frequency response and Applications.

Elastic transducers: springs, bellows, diaphragms and Bourdon tube.
Combination of elastic and electric transducers.

Thermocouple: Characteristics, installation and compensation. Measuring Circuits.

Magnetostrictive transducers: applications in flow measurements. Different types of flow transducers and their principles of operation.

Transducers for acceleration, vibration and shock

Digital transducers.

References/Books:

1. Measurement Systems: Application and Design: Doebelin E O, TataMcGraw

2. Transducers and Instrumentation: Murthy DVS, PHI New Delhi

3. Sensors and Transducers: Patranabis D, Wheeler, 1996.

4. Instrumentation, Measurement and Feedback: Jones, BE, TMH