Review of vector analysis, Orthogonal co-ordinate systems, Review of vector calculus in all the three coordinate systems: line, surface & volume integrals, gradient, divergence & curl of a vector & their physical significance, Divergence theorem, Stokes theorem, solenoidal and irrotational fields.

Gauss law in electrostatics & its applications, uniform line, surface & volume charge distributions, concepts of electric field & electric potentials, electric field & potential due to a linear dipole, Spherical & cylindrical capacitor, energy density in electric field, method of images.

UNIT II
Magnetoostatics: Magnetic flux density and magnetizing field intensity, Biot Savart's law, Amperes circuital law & its applications. Magnetic vector potentials, Magnetic field energy, boundary conditions for both the electric & magnetic fields at the interface of various types of media. Laplace, Poisson's equation & continuity equation, displacement current density, conduction current density, Maxwell's equations in differential & integral forms, time harmonic cases & their physical significance, retarded potentials.

UNIT III
UPW: Plane waves & uniform plane waves and their properties, wave equations in various media. Polarization & its types. Intrinsic impedance, propagation constant. Reflection & refraction of uniform plane waves at the interface of conductor-dielectric & dielectric-dielectric (both normal and oblique incidence). Relaxation time, skin effect, skin depth & surface impedance, Poynting vector theorem & its physical significance.

UNIT IV
Transmission Lines: Distributed parameters, circuit parameters, concepts of voltage & current flow on a transmission line, line equations, characteristic impedance. Reflection of transmission line, maxima & minima, standing wave ratio of a transmission line. Impedance matching, Smith's chart & its applications, co-axial type transmission line.
Introduction to Waveguides: (Qualitative study only) Concept of Wave Guide and TE, TM and TEM modes in rectangular and circular wave guides. Cut off and guide wave length, characteristic impedance, dielectric wave guide.

References:
1. Electromagnetic Fields & Waves by Sadiku (Oxford Univ. Press)
2. Fields & Waves Electromagnetics by D.K. Cheng. (Pearson Education)
3. Electromagnetics by J.D. Kraus.

NOTE: Eight questions are to be set in total covering entire course selecting two questions from each unit. Each question will be of equal marks. Students will be required to attempt five questions in all, selecting at least one question from each unit.
UNIT-I
INTRODUCTION: Control system-open loop & closed loop, servomechanism. MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Differential equation of physical systems, transfer function, block diagram algebra, signal flow-graphs, Mason’s formula & its application.
FEEDBACK CHARACTERISTICS OF CONTROL SYSTEMS: Feedback and non-feedback systems, Effects of feedback on sensitivity (to parameter variations), stability, overall gain etc.

UNIT-II
TIME RESPONSE ANALYSIS: Standard test signals, time response of first order and second order systems, steady-state errors and error constants, design specification of second-order-systems.

UNIT-III
FREQUENCY RESPONSE & STABILITY ANALYSIS: Correlation between time and frequency response, Polar Plots, Nyquist plots, Bode Plots, Nyquist stability criterion, Gain margin & Phase margin, relative stability using Nyquist Criterion, frequency response specifications.

UNIT-IV
COMPENSATION OF CONTROL SYSTEMS: Necessity of compensation, Phase lag compensation, phase lead compensation, phase lag lead compensation, feedback compensation.
STATE VARIABLE ANALYSIS: Concept of state, state variable and state model, state models for linear continuous time systems, diagonalization solution of state equations, concept of controllability and observability.
CONTROL COMPONENTS: Working principle of synchros, ac & dc tacho-generators, servomotors, magnetic amplifier, stepper motor.

TEXT BOOK:

Reference Books:
1. Control Systems: R.S. Chauhan, (Umesh Pub.)
2. Automatic Control Systems: B.C. Kuo; PHI.
3. Modern Control Engg: K. Ogata; PHI.

NOTE: Eight questions are to be set in total covering entire course selecting two questions from each unit. Each question will be of equal marks. Students will be required to attempt five questions in all, selecting at least one question from each unit.
ET-305-E POWER ELECTRONICS – I

L T P Internal : 30 Marks
3 1 0 External : 70 Marks
Credit : 3.5
DURATION OF EXAM : 3 HRS

UNIT I

INTRODUCTION :
Role of power electronics, review of construction and characteristics of power diode, Shottky diode, power transistor, power MOSFET, SCR, DIAC, Triac, GTO, IGBT & SIT.

UNIT – II

Ratings and protections, series and parallel connections, R, RC and UJT firing circuit and other firing circuits based on ICs and microprocessors; pulse transformer and opto-coupler, commutation techniques.

AC REGULATORS :
Types of regulator, equation of load current, calculation of extinction angle, output voltage equation, harmonics in load voltage and synchronous tap changer, three phase regulator.

UNIT - III

CONVERTERS :
One, two, three, six and twelve pulse converters, fully and half controlled converters, load voltage waveforms, output voltage equation, continuous and discontinuous modes of operation, input power factor of converter, reactive power demand effect of source inductance, introduction to four quadrant / dual converter, power factor improvement techniques, forced commutated converter, MOSFET and transistor based converters.

UNIT – IV

CYCLOCONVERTERS (A.C. to A.C. CONVERTER) :
Basic principle of frequency conversion, types of cycloconverter, non-circulating and circulating types of cycloconverters. Classification, principle of operation of step up and step down cycloconverter, single phase to single phase cycloconverter with resistive and inductive load. Three phase to single phase cycloconverter : Half wave and full wave. Cosine wave crossing technique. Three phase to three phase cycloconverter. Output voltage equation of cycloconverter.

TEXT BOOK :
1. Power Electronics : MH Rashid; PHI

REFERENCE BOOKS :
1. Power Electronics : PC Sen; TMH
2. Power Electronics : HC Rai; Galgotia
3. Thyristorised Power Controllers : GK Dubey, PHI

NOTE: Eight questions are to be set in total covering entire course selecting two questions from each unit. Each question will be of equal marks. Students will be required to attempt five questions in all, selecting at least one question from each unit.
UNIT I
Electronic Instruments: Instruments for measurement of voltage, current & other circuit parameters, R.F. power measurements, introduction to digital meters.

UNIT II
Digital Instruments: Digital Indicating instruments, comparison with analog type digital display methods, theory and applications of digital voltmeters, Electronic Galvanometers, Q-meter.
Frequency Measurements: Study of decade counting assembly (DCA), Measurements of frequency using cavity wave-meter. Heterodyne frequency meter, Digital frequency meter.

UNIT III
Transducers: Classification types: Photocell, thermocouples etc. basic schemes of measurement of displacement, velocity, acceleration, strain, pressure, temperature, liquid level.

UNIT IV
Instruments For Signals Generation: Square wave and pulse generators, Function generators, Random noise generators, Frequency Synthesizer.
Display Devices: Nixie Tube, LED, LCD, Discharge device.

References:
2. Electronics Instruments & Measurements techniques: By Helffrick & Cooper (PHI)

NOTE: Eight questions are to be set in total covering entire course selecting two questions from each unit. Each question will be of equal marks. Students will be required to attempt five questions in all, selecting at least one question from each unit.
ET-311-E  Control System Lab.

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List of Experiments

1. Experiment to study D.C. Position control system.
2. Experiment to study linear system simulator.
3. Experiment to study light intensity control using P & PI controller with provision for disturbance and transient speed control.
4. Experiment to study D.C motor speed control.
5. Experiment to study the stepper motor characteristics and its control through microprocessor kit.
6. Experiment to study Temperature control system.
7. Experiment to study Compensation design.
8. Experiment to study relay control system.
9. Experiment to study Potentials Metric Error detector.
10. Experiment to study SC Position control system.
11. Experiment to study synchros.

NOTE: At least 7 experiments are to be performed from the above list, other than this, two more experiments are to be performed depending upon the scope.
LIST OF EXPERIMENTS:

1. Experiment to measure displacement using LVDT.
2. Experiment to study & display parameter(liquid flow etc.) using LDR.
3. Experiment to measure temperature using RTD.
4. Experiment to measure temperature coefficient of material using thermocouple.
5. Experiment to measure pressure using strain guage.
6. Experiment to measure the distortion in amplifiers using distortion meter.
7. Experiment to study Op-Amp as instrumentation amplifier.
8. Experiment to study Op-Amp. as half wave & full wave precision rectifier.
9. To study & analyse CRO,sampling & storage CRO, digital CRO.
10. Experiment to study Op-Amp as AD/DA converter.
11. To study Nixie tubes,LED,LCD,discharge devices & familiarize with digital frequency meter,frequency synthesizers.
12. Experiment to measure the speed of d.c. motor using magnetic pick up.
13. Experiment to measure the speed of d.c. motor using photo-electric pick up.
14. To study Q-meter,digital data acquisition systems,random noise generator.

NOTE : At least 7 experiments are to be performed from the above list,other than this, two more experiments are to be performed depending upon the scope.
**LIST OF EXPERIMENTS :**

1. Experiment to study characteristics of diode, thyristor and triac.
2. Experiment to study characteristics of transistor and MOSFET.
3. Experiment to study R and R-C firing circuits.
4. Experiment to study UJT firing circuit.
5. Experiment to study complementary voltage commutation using a lamp flasher.
6. Experiment to study complementary voltage commutation using ring counter.
7. Experiment to study thyristorised d-c- circuit breaker.
8. Experiment to study a.c. phase control.
9. Experiment to study full wave converter.
10. Experiment to study dc chopper.
11. Experiment to study series inverter.
12. Experiment to study of bridge inverter.
13. Experiment to study of single phase cycloconverter.

**Note :** At least 7 experiments are to be performed from the above list, other than this, two more experiments are to be performed depending upon the scope.