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|| अंतरी पेटवू ज्ञानज्योत ||

North Maharashtra University,

Jalgaon

Syllabus for Second Year Engineering Degree Course in

INSTRUMENTATION

(w.e.f. July, 1999)

North Maharashtra University, Jalgaon

Syllabus for S.E. (Instrumentation)

(With Effect from July, 1999)

SEMESTER I

Sr. No.	Subject Code	Subject	Teaching Scheme Hours / Week		Examination Scheme				
			Lectures	Practical	Paper duration Hours	Maximum Marks			
						Paper	Termwork	Practical	Oral
1		Industrial Instrumentation	4	2	3	100	25	25	–
2		Electronic Devices and Circuits	4	4	3	100	25	25	–
3		Digital Techniques	4	2	3	100	25	25	–
4		Electromagnetic Engineering *	4	–	3	100	25	–	–
5		Workshop Technology and Fabrication Techniques	4	2	3	100	25	–	–
		Total	20	10	–	500	125	75	–
		Grand Total	30		–	700			

SEMESTER II

Sr. No.	Subject Code	Subject	Teaching Scheme Hours / Week		Examination Scheme				
			Lectures	Practical	Paper duration Hours	Maximum Marks			
						Paper	Termwork	Practical	Oral
1		Transducers and Signal Conditioners	4	4	3	100	25	25	–
2		Engineering Materials	4	2	3	100	25	25	–
3		Electrical Machines **	4	2	3	100	25	–	–
4		Thermal and Fluid Power Engineering	4	2	3	100	25	25	–
5		Engineering Mathematics III *	4	–	3	100	25	–	–
		Total	20	10	–	500	125	75	–
		Grand Total	30		–	700			

Total Marks of Term I + II = 1400

* Common Paper with S. E. (Electronics, Electronics and Telecommunication, Industrial Electronics, Computer, Electrical)

** Common Paper with S.E. (Electronics, Electronics and Telecommunication, Industrial Electronics, Computer)

Semester-I, Paper-I

Industrial Instrumentation

Teaching Scheme :
Lectures : 4 Hrs./Week
Practical : 2 Hrs./Week

Examination Scheme :
Theory Paper : 100 Marks
(3 Hrs. Duration)
Termwork : 25 Marks
Practical : 25 Marks

Unit 1

Introduction : Measurement and Instrumentation; static and dynamic characteristics of instruments; types of errors and their remedies; data types. Comparison of analog and digital instruments. Instrument specifications.

Measurement standards for time, frequency, voltage and current. ANSI, ASME, ASA, BS, DIN, CSMR, FCI, API, ISI standards. Introduction to reliability and safety. (6 Hrs.)

Response of indicating instruments for step, linear and sinusoidal inputs. Relation between undamped natural frequency, damped natural frequency, damping ratio and settling time of second order system. (4 Hrs.)

Unit 2

Measuring Instruments (D.C.) : Ballistic galvanometer, Ammeter, Voltmeter, Ohmmeter; Multimeter - multirange ammeter, voltmeter and ohmmeter, shunts and multipliers - design and operation. (5 Hrs.)

Measuring Instruments (A.C.) : Ammeter, Voltmeters, Electrodynamometers, Phase and line frequency meters, energy meters, effects of frequency and waveforms on their operation, testing and calibration. Electronic techniques (block schematic) of measurement of current, voltage, phase, power and energy. (5 Hrs.)

Unit 3

DC bridges : Wheatstone bridge - design, bridge sensitivity, analysis by Thevenin's theorem, errors in measurement, null type and deflection type - their comparison. Current and voltage sensitive bridges, kelvin bridge. (4 Hrs.)

AC bridges : Maxwell bridge, Hay bridge, Wien bridge, Anderson bridge, Schering bridge, storage and dissipation factors and their measurement. (6 Hrs.)

Unit 4

Potentiometers : Measurement of voltage and current calibration, sensitivity, self balancing techniques, multirange potentiometers. Insulation testers. (4 Hrs.)

Recorders : Curvilinear and rectilinear recording, ink pen, ink jet, thermal, galvanometric recorders, magnetic, oscillographic recorders, Y-t (Strip-chart and Circular chart), X-Y, single and multichannel recorders, driving systems for pen and chart, types of inks and charts, chart speeds. (6 Hrs.)

Unit 5

General purpose Cathode ray oscilloscope : CRT, block schematic, controls on CRO panel, measurement of phase, frequency, time duration, rise and fall time, amplitude. Z modulation using C.R.O. Introduction to X-Y and dual trace oscilloscopes, synchronization, Z-modulation. Lissajous figures. (10 Hrs.)

References :

1. Electronic Instruments and Measurements, Jones and Chin.
2. Electronic Instrumentation and Measurement Techniques 3rd edition, Cooper and Helfrick, Prentice-Hall of India.
3. Electrical and Electronic Instrumentation and Measurements 4th edition, A. K. Sawhney, Dhanpat Rai and Sons.
4. Electrical Measurements, Baldwin.

List of Experiments :

Group A

1. Design and calibration of multirange ammeter and voltmeter.
2. Design and calibration of series-type ohmmeter.
3. Design and calibration of shunt-type ohmmeter.
4. Wattmeter configurations for resistive power measurement and its calibration.
5. Output - power measurement.
6. Energy meter calibration.
7. Measurement of voltage, frequency and phase on CRO.

Group B

8. Study of Y-t and X-Y recorders, frequency response of Y-t recorder.
9. Calibration of ammeter, voltmeter and wattmeter by using dc potentiometer.

10. Design of Wheatstone bridge and plot of a graph of R Vs deflection.
11. Measurement of inductance using Maxwell bridge / Hay bridge.
12. Measurement of capacitance using Schering bridge.
13. Application of Wien bridge for measurement of frequency.

The termwork should include a minimum of eight experiments, foureach from Group A and B of the above list. The termwork marks will be based on performance in theory and practicals, having a weightage of 40% and 60% respectively.

Semester-I, Paper-II
Electronic Devices and Circuits

Teaching Scheme:
Lectures: 4 Hrs./Week
Practical: 4 Hrs./Week

Examination Scheme:
Theory Paper: 100 Marks
Termwork: 25 Marks
Practical: 25 Marks

Unit 1

Diode Circuits: Diode as a circuit element, load-line concept, piecewise linear diode model; static and dynamic resistances of a diode; Clipping circuits; Rectifiers, half-wave, full-wave and full-wave bridge, ripple factor and regulation; capacitor filters; clamping circuit; voltage multipliers, doubler, tripler and quadrupler. (10 Hrs.)

Unit 2

Transistors at low frequencies: h-parameters, analysis of a transistor amplifier using h-paramaters. Cascading transistor amplifiers, CE-CC, CC-CE, CE-CE, analysis of mid-band gain, input and output impedances. High input resistance circuits, Mille theorem, Darlington circuit, bootstrapping. (6 Hrs.)

Transistor biasing and thermal stabilization: Bias stability, stability factors, comparison of different biasing methods. Bias compensation, thermal runway, thermal stability. (4 Hrs.)

Unit 3

Transistor at high frequencies: hybrid-pi common emitter transistor model, hybrid-pi conductances and capacitances, single stage CE transistor amplifier analysis, gain bandwidth product. (4 Hrs.)

Field effect transistors: Junction field-effect transistor, V-I characterstics, small-signal model; MOSFET, enhancement and depletion types; low-frequency common-source and common-drain amplifiers, gain and impedance calculations; biasing the FET. FET amplifier analysis at high frequencies. (6 Hrs.)

Unit 4

RC-coupled amplifier: Low frequency response of RC-coupled transistor/FET amplifiers; high frequency response of two CE cascaded stages power amplifiers: Class A, B, AB, efficiency and distortion. (5 Hrs.)

Feedback amplifiers: Positive and negative feedback, types of negative feedback amplifiers, advanatges of negative feedback Barkhausen criterion, RC and LC oscillators, Crystal oscillator. (5 Hrs.)

Unit 5

Multivibrators: Bistable, Monostable and astable using transistors. Voltage Saw-tooth generator. (3 Hrs.)

Regulated Power supplies: Series regulator, overload and short-circuit protection circuit. Switching mode power supply, block digram and operation. (3 Hrs.)

Passive Components: Resistors, Capacitors and Inductors, types, construction and tolerances. Monolithic integrated circuits. (4 Hrs.)

References:

1. Electronic Principles, 5th edition, Malvino, Tata McGraw-Hill.
2. Integrated Electronics, Millman and Halkias, Tata McGraw-Hill.
3. Electronic Devices and Circuits, Salivahanan, Kumar, Vallavaraj, Tata McGraw-Hill.
4. Electronic Devices and Circuits, Allen Mottershead, Prentice-Hall of India.

List of Experiments:

Group A

1. Diode clipping circuits.
2. Half wave rectifier with capacitor filter. To find ripple factor and regulation.
3. Full-wave bridge rectifier with capacitor filter. To find ripple factor and regulation.
4. Diode clamping circuit.

5. Voltage multipliers, doubler, tripler and quadrupler.
6. To find input, output impedances and voltage gain for a bootstrapped Darlington circuit.
7. To find parameters of a FET.
8. To find frequency response of a RC coupled amplifier.

Group B

9. (a) Observe the output of a class B push-pull power amplifier.
   (b) Compare the output when it is operated in class AB operation.
10. For a phase-shift RC oscillator, measure the output voltage and frequency. Compare with the desired values.
11. For a Crystal oscillator, measure the output voltage and frequency. Compare with the desired values.
12. Observe the output waveform of a astable multivibrator. Compare with the designed values.
13. Observe the output of a monostable multivibrator andcompare with the designed values.
14. Observe the output of a voltage saw-tooth generator. Compare with the designed values.
15. To find line and load regulation of series regulator.
16. Plot the output voltage of the series regulator when it is overloaded.

The termwork should include a minimum of twelve experiments, six each from groups A and B of the above list. The termwork marks will be based on performance in theory and practicals, having a weightage of 40% and 60% respectively.

Semester-I, Paper-III

Digital Techniques

Teaching Scheme:
Lectures: 4Hrs./Week
Practical: 2 Hrs./Week

Examination Scheme:
Theory Paper: 100 Marks
(3 Hrs. duration)
Termwork: 25 Marks
Practical: 25 Marks

Unit 1

Fundamental Concepts: Digital signals, digital circuits, exclusive-OR operation, implementation of logical expressions by using universal gates such as NAND and NOR. Boolean algebra, minimization of logical expression. (6 Hrs)

Signed binary numbers, excess-3 code, gray code, hamming code, ASCII code. Comparison of digital logic families such as RTL, DCTL, I2L, DTL, HTL, TTL, PMOS and CMOS. Characteristics of digital ICs. (4 Hrs)

Unit 2

Combinational logic design: Standard representation for logical functions, SOP and POS forms, minterm and maxterms. Simplification of logical functions specified in minterm or maxterm or alongwith don't care conditions using K-map. Some design examples such as full adder, full subtractor, binary to seven segment decoder. (10 Hrs)

Unit 3

Combinational design using MSI circuits: Multiplixer, demultiplxer, adders, digital comparators, parity generator / checkers. Code converters, BCD to binary, binary to BCD, BCD to excess-3, binary to gray. (10 Hrs)

Unit 4

Sequential logic design: One bit memory cell, clocked S-R flip-flop, preset and clear, J-K flip-flop, master slave J-K flip-flop. D and T types of flip-flops, excitation tables of flip-flops, conversion of one type of flip-flop to another type. (4 Hrs)

Registers, classifications, shift registers, counters, synchronous and asynchronous. Analysis of clocked sequential circuits, state table, state diagram, next state equation and state reduction. (6 Hrs)

Unit 5

Digital to analog convertor, weighted register D/A convertor, R/2R ladder D/A convertor. Analog to digital convertor, parallel comparator A/D convertor, successive approximation A/D convertor, dual slope A/D convertor, specification of A/D convertor (5 Hrs)

Digital storage devices such as ROM, RAM, EPROM, EEPROM, CAM (Content Adderasable Memeory), CCD. ROM as PLD and PLA. PAL, field programmable gate arrays, ERA (Electrically Reconfigurable Array). (5 Hrs)

References:

1 Modern Digital Electronics, 2nd edition, R. P. Jain, Tata-McGraw-Hill.
2. Digital Logic and Microprocessor, Hill and Peterson, John Wiley and Sons.
3. Digital Principles and Applications, Malvino and Leach.
4. Digital Logic and Computer design, M.Morris Mano, Prentice-Hall of India.

List of Experiments :

1. Implementation of logical expression using NAND/NOR gates.
2. Verification of De-Morgan's theorem.
3. Implementation of full adder circuit by using two half adders.
4. Implementation of 4-bit adder / subtractor circuit by using 7483.
5. Implementation of logical expression by using MUX.
6. Implementation of logical expression by using DEMUX.
7. Implementation of one and two bit comprators.
8. Implementation of BCD to excess-3 code convertor.
9. Implementation of binary to gray and gray to binary code convertor.
10. Implementation of mod-n counter by using flip-flop.
11. Implementation of ring counter using 7493.
12. Implementation of sequence generator and detector using 7495.

The termwork should include a minimum of eight experiments from the above list. The termwork marks will be based on performance in theory and practicals, having a weightage of 40% and 60% respectively.

Semester-I, Paper-IV

Electromagnetic Engineering

(Common with Electronics, Electronics & Telecommunication, Industrial Electronics, Computer, Electrical Engineering)

Teaching Scheme :
Lectures : 4 Hrs./Week

Examination Scheme :
Theory Paper : 100 marks
(3 Hrs. duration)
Termwork : 25 marks.

Unit 1

Electrostatics : Coulomb's law, electric field intensity, field due to continuous volume charge distribution, line charge, sheet of charge. Electric flux density, Gauss' law, application, divergence theorem. Energy and potential; potential gradient. The dipole, its electric field, dipole moment. Energy density in electrostatic field. (10 Hrs.)

Unit 2

Conductors, dielectrics and capacitance : Current and current density, continuity of current, conductor properties and boundary conditions. Nature of dielectric materials, boundary conditions for perfect dielectric materials. Capacitance of parallel plates, energy stored, capacitance of coaxial cable, two-wire line. (10 Hrs.)

Unit 3

Magnetostatics : Biot-Savart law, application to infinitely long current carrying conductor, Ampere's circuital law, application to coaxial cable. Curl operator. Magnetic flux and flux density. Scalar and Vector magnetic potentials. Lorentz force equation. Magnetization and permeability. Magnetic circuit. Energy stored in magnetic field. (10 Hrs.)

Unit 4

Time-varying fields : Faraday's law, Maxwell's equations, Maxwell's equations in integral form, boundary conditions. (4 Hrs)

Uniform plane wave : Wave motion in free space, in perfect dielectrics, in lossy dielectrics, Poynting vector and power density. Propogation in good conductors, skin effect. Reflection of uniform plane waves. Standing wave ratio. (6 Hrs.)

Unit 5

Radiation and Antennas : Radiated power, radiation resistance for short dipole, short monopole, halfwave dipole and quarter wave monopole antennas. Radiation pattern and directivity. Reciprocacity between transmitting and receiving antennas. Folded dipole and yagi antenna. (6 Hrs.)

Antenna arrays : General pattern of two Isotropic radiators, broadside and end fire arrays. Binomial and Tchebysheff arrays. Principle of pattern multiplication. (4 Hrs.)

References :

1. Engineering Electromagnetics, 5th edition, W. Hayt, Tata McGraw-Hill.
2. Electromagnetics, 4th edition, J. D. Kraus, McGraw-Hill International.
3. Electromagnetic Waves and Radiating Systems, second edition, Jordan and Balmain, Prentice-Hall of India.
4. Antennas, second edition, J.D. Kraus, McGraw-Hill International.
5. Basic Electromagnetics with Applications, Narayana Rao, Prentice-Hall of India.

Semester-I, Paper-V

Workshop Technology and Fabrication Techniques

Teaching Scheme :
Lectures : 4Hrs./Week
Practical : 2 Hrs./Week

Examination Scheme :
Theory Paper : 100 Marks
(3 Hrs. duration)
Termwork : 25 Marks

Unit 1

Sheet Metal Working : Study of various processes such as shearing, blanking, punching, notching, bending, forming, drawing, coining, swaging, spinning, rolling and tube bending etc.

Equipments used for sheet metal working : Crank press, toggel press, single and double acting press.

PCB Art Work and Surface Treatment : Etching, Anodising, Electroplating etc. (10 Hrs)

Unit 2

Joining Processes : Arc welding, resistance welding, gas welding, TIG and MIG welding process, equipment, applications of additives, brazing, soldering.

Casting : Pattern making, moulding, elementary and special moulding and casting process, centrifugal casting, investment casting, continous casting processes, die casting, high and low pressure die casting, hot chamber and cold chamber die casting processes, metals used for die casting. (10 Hrs)

Unit 3

Study of Machine Tools :

Lathe Machine : Types of lathe, different operations performed on lathe such as turning, facing, boring, thread cutting, parting, chamfering, knurling etc. Standard accessories and attachments, tools.

Milling, Drilling, Planning, Slotting, shaper machines : Their types, different operations performed, field of applications, different tools used.

NC/CNC Machines and Robots :

a. NC/CNC Machines - classification, basic components of NC/ CNC systems, NC/CNC control systems, fundmental and system devices, feedback devices, NC actuation system, control devices, DNC etc.

b. Robot - classification and applications. (12 Hrs)

Unit 4

Standards of Measurements : Line and End standards, Interchangeable systems, Limits fits and their systems, limit gauging, surface finish measurement, ISO - 9000 Introduction.

Linear Measurements :

Vernier Callipers, Micrometers, Height gauge, Bore gauge, Slip gauges and their uses, Surface plates

Angular Measurements : Angular gauges, protractors, levels, sinebar, autocollimators, clinometers, dividing heads and special methods of angular measurements. (8 Hrs)

Unit 5

Non-Conventional Machining Processes : Introduction, Principles of USM, EDM, LBM, IBM, CM, ECM, AJM etc.

Plastics and Plastic Processing : Introduction to Plastics and Plastic moulding processes, Injection moulding, Blow moulding, Compression moulding, Extrusion etc. (10 Hrs)

WorkShop Jobs :

1. Composite job including operations on Lathe, Milling and Drilling Machines - one job.
2. Welding / Soldering - one job.
3. PCB Etching, Drilling etc - one job.
4. Sheet metal working Chassis / Panel box - one job.
5. Reports of machine tools based on above syllabus.

The termwork shall consist of the above jobs. The termwork marks will be based on performance in theory and practicals, having a weightage of 40% and 60% respectively.

Semester-II, Paper-I

Transducers and Signal Conditioners

Teaching Scheme :
Lectures : 4Hrs./Week
Practical : 2 Hrs./Week

Examination Scheme :
Theory Paper : 100 Marks
(3 Hrs. duration)
Termwork : 25 Marks
Practical : 25 Marks

Unit 1

Transducers : Definition, classification, selection criteria, errors, loading effects, basic configuration of control system, transducer specifications. (3 Hrs)

Displacement, force and torque transducers : Displacement-resistive, inductive, eddy current, strain gauge, capacitive, piezo-electric, digital, fiber optic, flapper nozzle, laser type transducers. Force measuring transducers, electric load cell, LVDT, piezo-electric, vibrating type. Torque-strain gauge and other suitable transducers. (7 Hrs)

Unit 2

Velocity, acceleration and vibration transducres : Tachometers, toothed rotor tachometers, photoelectric, stroboscopic principles, theory of acceleration and vibration pick-ups, their calibration, types of accelerometers, ferkmeter. (4 Hrs)

Temperature transducers: temperature scales, glass thermometer, bimetallic and memory shaped alloy thermometers, filled system thermometer, semiconductor temperature detector (termistor and p-n junction), resistance thermometer, thermocouples, ultrasonic, crystal, Infrared thermometer. (6 Hrs)

Unit 3

Level transducers : for liquid and solids - float type displacer, air purge method, diaphragm box level gauge, DP cell, load cell, bicolor direct reading, vibrating, ultrasonic, radioactive transducer, reed switches, microwave. (5 Hrs)

Flow transducers : Basic measurement principle, Bernoulli's theorem, differential pressure type (orifice, ventury, annbar, pitot type), variable area type, turbine type, target type, magnetic, ultrasonic, vortex shedding, cross co-relation, positive displacement type, mass flow meter, annemometer, total flowmeter. (5 Hrs)

Unit 4

Pressure transducer : Pressure scales and standards, manometers, elastic (bellows, bourdon tube, diaphragm) type, dead weight and vacuum gauge testers, electrical pressure sensors (LVDT, strain gauge, load-cell, piezo-electric, capactive), tuning fork type, differential pressure sensors (capactive, force balance and vibrating cylinder type), vacuum pressure measurement - Mcleod gauge, thermal conducting and ionization type, transducers for very high pressure measurement. (6 Hrs)

Viscosity and density sensing and measurement : Capillary type, saybolt type, Shearle's rotating cylinder, cone and plate, falling and rolling ball type viscometers. Hydrometers, gravitrol meters, buoyancy type, DP cell type and electrical density sensors. (4 Hrs)

Unit 5

pH and conductivity sensors : pH scale and standards, principle of pH measurement, different types of reference and measuring electrodes, Ion-selective electrodes. Principle of conductivity measurement, conductivity cells and bridges - their applications. Effects of temperature on pH and conductivity sensors. (5 Hrs)

Humidity and misc. transducers : Psycrometer, Hygrometer (Hair, Wire and Electrolysis type), Dew point meter, piezoelectric humidity meter, infrared conductance and capacitive type probes for moisture measurement.

Flow detectors, leak detectors, flame detectors, smoke detectors, acoustic tansducers and sound level measurement. (5 Hrs)

References :

1. Measurement System, 4th edition, E. O. Doeblin, McGraw-Hill International.
2. Principles of Industrial Instrumentation, 2nd edition, Patranabis, Tata McGraw-Hill.
3. Experimental methods for Engineering, J. P. Holman.
4. Mechanical and Industrial Measurement, R. K. Jain.

List of Experiments :

Group A

1. Testing and calibration of T, J, K, R and S thermocouples.
2. Calibration of Pt-100
3. (a) Calibration of strain indicator,
   (b) Weight measurement by load cell.
4. Study of LVDT and its applications in thickness measurement.
5. Level measurement by (a) Capacitance probe, (b) Air purge method,

(c) density measurement by air purge method.

6. Flow measurement by (a) orifice with manometer,

(b) Vacuum gauges by vacuum gauge tester.

Group B

7. Study of Bellows, Bourden tubes and diaphragms.

8. RPM measurement using photodetector technique.

9. Vibration measurement by vibrometer.

10. Study of electric pressure probes.

11. Study of PH meter, conductivity meter and their calibration.

12. Humidity measurement by psychrometer.

The termwork should include a minimum of eight experiments, four each from groups A and B of the above list. The termwork marks will be based on performance in theory and practicals, having a weightage of 40% and 60% respectively.

Semester-II, Paper-II

Engineering Materials

Teaching Scheme:
Lectures: 4Hrs./Week
Practical: 2 Hrs./Week

Examination Scheme:
Theory Paper: 100 Marks
(3 Hrs. duration)
Termwork : 25 Marks
Practical : 25 Marks

Unit 1

Classification and properties of materials: metals, non-metals such as ceramics, plastics and polymers, composite materials. Structure of materials: Structures, general relationship of the stuctural level to various engineering properties, atomic structure, bonding in solids, atomic arrangements in material, crystal structure of metals, space lattice, unit cell, indexing of lattice planes and directions, development of metallic grains; plastic deformation, mechanisms, deformation of single crystal and polycrystalline metals. Imperfection in crystals, dislocation theory of slippage, workhardening, stregthening mechanisms in metals; cold working and hot working of metals and process like rooling, forging, extrusion, wire-drawing. Alloys types and phases in alloys.

(10 Hrs)

Unit 2

Mechanical Testing: Tensile test-engineering and true stress-strain curve, significance of the test, evaluation of properties, typical stress-strain diagrams, types of tensil specimen fracture; compression test, cupping test on sheet metal. Hardness test; Brinell, Poldi, Vickers, Rockwell, scleroscope, Microhardness test, hardness conversion and correlation with strength, Impact test, fatigue test and creep test. non-destructive testing; liquid penetrant method, magnetic particle inspection, eddy-current, radiographic and ultrasonic inspection.

(10 Hrs)

Unit 3

Equilibrium diagrams and their construction, common types of equilibrium diagrams, information given by a phase diagram, tie live rule, lever rule, Gibb's phase rule and non-equilibrium cooling.

Steels: plain carbon and alloy steels.

Plain carbon steels, iron-carbon phase diagram. Critical temperatures allotropy, cooling curve and volume changes of pure iron, microstructures of slowly cooled (equilibrium cooled) steels, non-equilibrium phase transformations, classification of iron-carbon alloys; classification and designation of steels, properties and application of steels.

Alloy Steels: effects of alloying elements, functions and uses of alloying elements, typical examples of alloy steels.

Tool Steels: composition and requirements, classification, selection and heat-treatment of tool steels.

Stainless Steels and high temeprature alloy: various types of stainless steels, selection and failure of stainless steel. (10 Hrs)

Unit 4

Heat Treatment of steels: Principles of heat treatment, phase transformations in steel during heating, transformation of Austenite during cooling; time-temperature transformation diagrams, critical cooling rate, continuous cooling transformation diagrams.

Heat Treatment Process: annealing normalizing, hardening, tempering and case-hardening.

Hardenability of steel, significance of hardenability, the Jominy-end quench test, other hardening heat treatment such as austempering, Martempering, Tempering of steel, grain size designation and control. Surface hardening, materials and applications of flame and induction heating. Carburizing of steel, heat treatment after carburizing, Nitriding, carbonitriding.

Heat treatment furnaces, their classifications, batch furnaces, continuous furnaces, furance controls, heat treatment and energy economics.

(10 Hrs)

Unit 5

Macro and micro-examination of metals.

Macroexamination : specimen preparation, Sulphur printing, now fies observation, specimen preparation for micro-examination, etching reagent, optical metallurgical microscope.

Cast Irons : Classification, grey and white cast irons, modular or ductile iron, malleable cast Iron, alloyed cast Iron, effect of various parameters on structure and properties of cast irons. Applications and heat treatment of cast irons.

Engineering non-ferrous alloys : Brasses; Bronzes, Tin, Aluminium, Silicon and Beryllium bronzes; Copper-nickel alloys; Aluminium and aluminium alloys. Titanium and its alloys; Solders and bearing materials. Common applications and some specifications of various non-ferrous alloys in field such as 1. Die casting Industry, 2. Automobile, 3. Aircraft Industry, 4. Ship building and marine engineering, 5. Refrigeration. (10 Hrs)

References :

1. Introduction to Engineering Materials, 6th edition, B. K. Agrawal, Tata McGraw-Hill.
2. Introduction to Physical Metallurgy, Avner, Tata McGraw-Hill.
3. The testing of Engineering Materials, Davis, Troxell and Hanck, McGraw-Hill International.
4. Material Science and Metallurgy for Engineers 3rd edition, V. D. Kodgire, Everest.
5. Experiments in Material Technology, C. A. Higgereson, East-West Press.

List of Experiments :

Group A

1. Tensile test on Mild steel and aluminium test pieces.
2. Brinell hardness test on steel, cat iron, brass, aluminium.
3. Rockwell and Rockwell superficial hardness test on different samples with different scales.
4. Erichson cupping test on minimum three different sheet metal samples.
5. Dye penetrant and magnetic particle and or eddy current testing.
6. Impact test.

Group B

7. Specimen preparation and use of metallurgical microscope.
8. Study and drawing of microstructure of mild steel, medium carbon steel, Eutectoid and hyper Eutectoid steel in annealed condition.
9. Study and drawing microstructure of white, malleable, grey and ductile cast Iron.
10. Jominy hardenability test on steel sample to determine steel hardenability.
11. Furnace Operation : To determine natural (empty furnace) heating and cooling rates on an available labratory furnace and to determine that length of heating up time plus holding time needed to heat treat steel in a furnace.
12. Sulphur print test on steel specimen or flow lines examination on forged component.

The termwork should include a minimum of eight experiments, four from each groups A and B of the above list. The termwork marks will be based on performance in theory and practicals, having a weightage of 40% and 60% respectively.

Semester-II, Paper-III

Electrical Machines

(Common with Electronics, Electronics & Telecommunication, Industrial Electronics, Computer Engineering)

Teaching scheme :
Lectures : 4 Hrs/week
Practicals : 2 Hrs/week

Examination scheme:
Theory paper : 100 marks
(3 Hrs. duration)
Termwork : 25 marks

Unit 1

Three phase circuits : Three phase supplies, phase sequence, connection of three phase windings, star and delta connections. Line and phase voltages and currents in star, delta connections. Power in three phase circuits with balanced load for star and delta connections. Measurement of power by two wattmeter method. Calculation of active and reactive powers. (5 Hrs.)

Magnetic circuits : Concept of mmf, magnetic flux, flux density, field strength, reluctance, permeability, their units and relationships. Series and parallel magnetic circuits. Comparison of electric and magnetic circuits. Hysteresis loss and eddy current loss. (5 Hrs.)

Unit 2

D.C. machines : Construction, types (shunt, series and compound), generator action, emf equation; motor action, significance of back emf, torque and speed equations; torque-armature current, speed-armature current and torque-speed characteristics of different types of motors, different methods of speed control; starter; applications. (10 Hrs.)

Unit 3

Transformers : Single phase transformer, construction, emf equation of transformer, voltage and current transformation ratios, transformer on no load, leakage reactance, transformer on load, phasor diagram, equivalent circuit, regulation, efficiency of transformer, open-circuit and short-circuit tests. Three phase transformers, star/star, delta/delta, star/delta, delta/star connections, Vee and Scott connections, Autotransformer, C.T. and P.T. (10 Hrs.)

Unit 4

Synchronous machines : Alternators, principle of operation, constructional features, synchronous speed, emf equation, winding factors, regulation by synchronous impedance method; Synchronous motors, principle of operation, rotating magnetic field, on no load, on load phasor diagrams, Vee curves, hunting, methods of starting. (10 Hrs.)

Unit 5

Induction motors : Three phase motors, principle of operation, slip, torque equation, torque-slip characteristic, relation between slip and rotor copper loss, equivalent circuit, different types of starters; application. Single phase induction motors, principles of working, types; applications. (7 Hrs.)

Special purpose machines : Principle, working and applications of stepper motor, servomotors and universal motors. (3 Hrs.)

References :

1. Electrical Technology, Edward Hughes, 6th edition, ELBS.
2. Basic Electrical Engineering, V.N. Mittle, Tata McGraw-Hill.
3. Electrical Machines, Second edition, Nagrath and Kothari, Tata McGraw-Hill.
4. Electrical Machines and Power Systems, V. Del Toro, Prentice-Hall of India.
5. Electromechanical Energy Conversion with dynamics of machines, R.D. Begamudre, New Age International.
6. Electrical Machines, second edition, S.K. Bhattacharya, Tata McGraw-Hill.

List of Experiments :

1. Two wattmeter method of power measurement in 3 phase balanced circuit.
2. Speed control of dc shunt motor by armature voltage and flux control methods.
3. Study of dc shunt motor starter.
4. Load test on dc shunt motor.
5. Load test on dc series motor.
6. O.C. and S.C. test of single phase transformer to determine regulation and efficiency.
7. Scott connection to convert 3-phase supply into 2-phase supply.
8. Regulation of alternator by synchronous impedance method.
9. Regulation of alternator by direct loading method.
10. To plot Vee curves and p.f. curve for synchronous motor.
11. Load test on 3-phase induction motor.
12. Study of various single phase motors.

The termwork should include a minimum of eight experiments from the above list. The termwork marks will be based on performance in theory and practicals having a weightage of 40% and 60% of the total marks respectively.

Semester-II, Paper-IV

Thermal and Fluid Power Engineering

Teaching Scheme :
Lectures : 4 Hrs/week
Practicals : 2 Hrs/week

Examination Scheme :
Theory Paper : 100 marks
(3 Hrs duration)
Termwork : 25 marks
Practical : 25 marks

Unit 1

Power plants system : Uses of compressed air, classification, construction and working of Air compressor, work input, concept of clearance volume, swept volume, volumetric and isothermal efficiences. Use, constructional features and working of high pressure boiler, condenser, steam turbine in thermal power stations. Gas turbine's classifications, cycle analysis and performance improvement. (10 Hrs)

Unit 2

Internal combustion engine : Classification, construction and working of S.I. and C.I. 2 stroke and 4 stroke engines. Calculations of IP, BP, FP, BSFC and efficiencies. Heat balance sheet. Study of fuel feeding, ignition, starting, governing, lubrication, etc. (10 Hrs)

Unit 3

Refrigeration and air conditioning : Refrigeration effect and its uses. Vapour compression cycle, calculation for vapour compression refrigeration system, coefficient of performance, TR capacity. Common refrigerants and their desirable properties. Air conditioner and their requirements. Properties of moist air, psychometric chart and its use. Psychometric process such as sensible heating and cooling, humidification and dehumidification. Study of central air conditioning plant. Refrigeration controls and industrial air conditioning. (10 hrs)

Unit 4

Introduction to heat transfer : Various models of heat transfer, fundamental laws of conduction, convection and radiation. Concept of thermal conductivity, heat transfer coefficient and emissivity, concept of black, grey and white body. Concept of natural and forced convection, overall heat transfer coefficient. (10 Hrs)

Unit 5

Introduction to fluid mechanics and machines : Compressible and incompressible fluids, basic definition, Bernoulli's equation, laminar and turbulent flow in channels and pipes. Friction factor, non-dimensional number. Water turbines, classification, power output and efficiencies. Centrifugal pumps : Constructional details and operating characteristics. (10 Hrs)

References :

1. Engineering Thermodynamics, P.K.Nag.
2. Thermal Engineering, R.K.Rajput.
3. Heat Transfer, Gupta and Prakash.
4. Hydraulic Machinery, Jagdish Lal.
5. Internal Combustion Engine, V.Ganeshan.
6. Basic Thermodynamics, T Roy Chawdhary.

List of Experiments :

Group A

1. Study of steam power plant.
2. Study of central air conditioning plant.
3. Study of fuel feeding systems in I.C. engines.
4. Study of ignition system of an I.C. engine.

Group B

5. Study and trial on petrol engine at one load.
6. Study and trial on reciprocating air compressor.
7. Study and trials of refrigeration systems.
8. Determination of thermal conductivity of metal rod.
9. Determination of Stefan Boltzmann Constant.
10. Study and trial on water turbine.
11. Study and trial on centrifugal pump.
12. Study and trial on diesel engine.

The termwork should include a minimum of eight experiments two from group A and six from group B. The termwork marks will be based on theory and practicals, having a weightage of 40% and 60% respectively.

Semester-II, Paper-V

Engineering Mathematics III

(Common with Electronics, Electronics & Telecommunication, Industrial Electronics, Computer, Electrical Engineering)

Teaching Scheme
Lectures : 4 Hrs./Week

Examination Scheme
Theory paper : 100 marks.
(3 Hrs duration)
Termwork : 25 marks

Unit 1

Linear differential equations of nth order with constant coefficients, method of variation of parameters. Homogenous linear D.E., Legendre's LDE, Simultaneous LDE, applications of simultaneous differential equations, application to electrical circuit. (10 Hrs.)

Unit 2

(a) Application of partial differential equations :

i. $\frac{\partial v}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$ (one-dimensional heat flow equation)

ii. $\frac{\partial^2 y}{\partial t^2} = a^2 \frac{\partial^2 y}{\partial x^2}$ (wave equation)

iii. Laplace equation or two dimensional heat flow equation

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

(5 Hrs.)

(b) Vector differentiation :

i) Differentiation of vector function.

ii) Tangential and normal components of linear acceleration, radial and transverse components of velocity and acceleration.

iii) Gradient of a scalar point function, Divergence and Curl of vector point function, irrotational and solenoidal vectors, vector identities.

(5 Hrs.)

Unit 3

Vector Integration :

i) Line integral, Surface integral, Volume integral.

ii) Green's lemma, Stoke's theorem, Gauss's divergence theorem.

iii) Applications to electromagnetic fields.

(8 Hrs.)

Unit 4

(a) Fourier transform, Inverse Fourier transform, properties and theorems; Fourier sine and cosine integrals; Fourier transform of standard functions; Applications of Fourier transform in sampling of signals. Discrete Fourier transform and its properties.

(6 Hrs.)

(b) Z-transform, definition of Z-transform, properties of Z-transform; Z-transform of standard sequences; Inverse Z-transform; relationship of Z- transform with Fourier transform; application of Z-transform.

(6 Hrs.)

Unit 5

Laplace transform, definition of Laplace transform, Inverse Laplace transform, properties and theorems; Laplace transform of standard functions, unit step function, ramp function, impulse function; methods of finding inverse transforms; Applications to solutions of LDEs.

(10 Hrs)

References :

1. A Text Book of Engineering Mathematics, P.N. Wartikar, J.N. Wartikar, Pune Vidyarthigrih.
2. Higher Engineering Mathematics, B.S. Grewal.
3. Advanced Engineering Mathematics, Wylie.
4. Advanced Engineering Mathematics, Erwin Kreyszing.