

BASIC ELECTRICAL & ELECTRONICS TECHNOLOGY

Paper Code : 143001

1. Overview of Electricity:

General use and applications of electricity; Use and applications of electricity to agriculture, Mechanical & Automobile sector; Advantages of electrical energy over other forms of energy. Introduction to basic terms: charge, current, voltage, power, and energy; Ohm's law; Power dissipation in resistors; Series and parallel combination of resistors; Kirchhoff's laws; Star-delta conversions; Thevenin's theorem, Norton's theorem, and Maximum-power-transfer theorem; Ideal and practical voltage source; Current source.

2. AC Circuits:

Concept of alternating voltage and current; Introduction to basic terms: cycle, frequency, time period, amplitude, instantaneous value, rms value, peak value, phase difference, form factor, and peak factor.

3. Batteries and Solar Cells:

Primary and secondary cells; Construction, working, and applications of Lead-Acid; Charging methods for Lead-Acid batteries; Maintenance of Lead-Acid batteries; Series and parallel connection of batteries; Maintenance free batteries; General idea of solar cells, solar panels and their applications.

4. Electrical Machines

Transformers; Efficiency and regulation; Operation of welding transformer, functions and basic principles of motors, types of motors, Construction and operation of stepper motors & Servo motor.

5. Semiconductors:

Classification of materials as conductors, insulators, and semiconductors; Intrinsic and extrinsic semiconductors; p-type and n-type semiconductors; pn-junction diode.

6. Electrical Installation and Safety:

Various Accessories and parts of electrical installation, overview of industrial and domestic wiring systems; Common electrical safety measures; Protection and precaution against electrical shock; Treatment of electrical shock.

MATERIAL SCIENCE & METALLURGY

Paper Code : 143002

1. Importance of Materials

1.1 Classification: Metals and non-metals, Ferrous and non-ferrous metals and their alloys.

1.2 Crystalline and non-crystalline structures; unit cells, Bravais space lattices, cubic closed pack structures, coordination number, miller indices, crystallographic planes and directions.

1.3 Structural imperfections- point, line, planar and volume defects, structure property relationship.

1.4 Names of common metals, their alloys and non-metals used in Industry.

1.5 Properties of metals and alloys.

1.6 Physical properties - Appearance, luster, colour, density and melting point.

1.7 Thermal and electrical conductivity.

1.8 Corrosion, causes, effects and prevention.

1.9 Study of creep and fatigue.

2. Ferrous Metals and Alloys

2.1 Flow diagram for the production of ferrous metals from their ores, constituents of iron, iron carbon diagram.

2.2 Classification, composition and uses of cast iron and plain carbon steels. IS, BS and SAE Grades.

2.3 Effect of alloying elements such as Aluminium, chromium, Nickel, Cobalt, Manganese, Molybdenum, tungsten, Vanadium, Silicon, Sulphur and Phosphorous on steels.

2.4 Composition, properties, and uses of special steels such as High speed steel, Stainless steels, Silicon steels, Heat resistant steels, Spring steel.

2.5 Heat Treatment: Iron-carbon diagram, objectives of heat treatment. Brief description and uses with examples of principal heat treatment processes, Annealing, Normalizing, Tempering, Hardening, Carburising, Nitriding and Cyaniding and applications, case hardening.

3. Iron Carbon Equilibrium Diagram

3.1 Phase transformation.

3.2 Nucleation and growth.

4. T-T-T Diagram

4.1 Importance of critical cooling rate.

4.2 Martensite transformation.

4.3 Nucleation and growth.

5. Non-ferrous Metals and Alloys

5.1 Copper: Properties and uses.

5.2 Composition, properties and uses of copper alloys.

5.3 Brasses: Cartridge brass, Nickel silver.

5.4 Bronzes: Phosphor bronze, Al-bronze, Mn-bronze, and Gun metal.

5.5 Properties and uses of Aluminium.

5.6 Composition, properties and uses of Al-alloys e.g., Duralumin, Yellow metal, Magnalium and Hindalium.

5.7 Properties and uses of alloys of lead, tin and magnesium.

5.8 Bearing Metals: Requisite qualities. Composition, properties and uses of white metal bearing, copper based bearing metals. Aluminium based bearing metals. Use of nylon/PTFE for bushes/bearings, bi-metallic and trimetallic bushes.

6. Other Important Materials

6.1 Plastics: Definition, classification of plastics, fibre glass, reinforced plastics. Major applications of various plastics and their uses and grades.

6.2 Composite materials.

6.3 Heat insulating materials: Properties and uses of asbestos, glass wool, thermo Cole, cork, mica.

6.4 Electrical insulating materials. Properties and uses of china clay, leather, bakelite, ebonite, glass wool, rubber, felt.

6.5 Sound insulating materials: Cork, fibre boards.

6.6 Fabrication materials: Wood, plywood, rubber – natural and synthetic, Glass – plate glass, toughened glass, safety glass.

6.7 Refractory materials: General characteristics and uses of dolomite, ceramics.

6.8 Protective coating materials: Paints, primers, varnishes, enamels, putti, electroplating materials, rubasil, Teflon coating.

6.9 Sealant and adhesives – Application and availability of sealant and adhesives for industrial user.

6.10 Smart materials.

MACHINE DRAWING

Paper Code : 143003

1. Introduction to Machine Drawing

- 1.1 Graphic language, classification of machine drawing, conventional representation.
- 1.2 System of orthographic projections. Third angle projection, first angle Projection No. of views required. One view, Two views, Three views drawing.
- 1.3 Sectioning- Material convention, important types of section- full section, half Section, revolved section and aligned section.
- 1.4 Temporary and permanent fasteners.

2-Bearings

- 2.1 Bush bearing.
- 2.2 Foot Step bearing.
- 2.3 Simple wall bracket.

3. Pulleys

- 3.1 Flat belt pulley.
- 3.2 V belt pulley.
- 3.3 Cone or stepped pulley.
- 3.4 Fast and loose pulley.

4. Pipe Joints

- 4.1 Flange joint.
- 4.2 Spigot and socket joint.
- 4.3 Threaded pipe joint.
- 4.4 Expansion joint.
- 4.5 Piping joint.

5. Assembling drawing from detail drawing

- 5.1 Stuffing box.
- 5.2 Eccentric.
- 5.3 Blow off cock.
- 5.4 Cross head.
- 5.5 Connecting rod.
- 5.6 Ram's bottom safety valve.
- 5.7 Stop valve.
- 5.8 Plummer block.
- 5.9 Tail stock.
- 5.10 Shaper tool head.
- 5.11 Machine vice.

5.12 Screw jack.

5.13 Swivel Bearing.

6. Gears and Gearing

6.1 Spur gear- Nomenclature, gear formula, method to draw base circle, involute curve, tooth profile.

6.2 Bevel gear- Nomenclature, gear formula, method to draw Bevel gear.

7. Free hand sketches

8. Jig, fixture and Gauges

8.1 Concept of jig and fixture, types of jig and fixture and applications.

8.2 Simple plate drill jig, drill jig for batch production.

8.3 Indexing fixture.

8.4 Introduction to gauges, use of Go-No Go gauge and ring gauge.

THERMODYNAMICS

Paper Code : 143004

1. Fundamental Concepts

Introduction, thermodynamic system, surrounding, boundary, state, universe, thermodynamic systems- closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic, properties of system - intensive and extensive, thermodynamic equilibrium, quasi - static process, reversible and irreversible processes, concept of work and heat, equality of temperature, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy, Simple numerical problems.

2. Laws of Perfect Gases

Definition of gases, concept of perfect gas, explanation of perfect gas laws - Boyle's law, Charles's law, Avagadro's law, Universal gas constant, Characteristic gas equations (Simple numerical problems) Specific heat at constant pressure, specific heat at constant volume of gas.

3. Thermodynamic Processes on Gases

Types of thermodynamic processes - isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, equations representing the processes Derivation of work done in various processes change in internal energy.

4. Laws of Thermodynamics

Law of conservation of energy, first law of thermodynamics (Joule's experiment), Application of first law of thermodynamics to non-flow systems -Constant volume, constant pressure, Adiabatic and polytropic processes, steady flow energy equation, Application of steady flow energy equation to turbines, pump, boilers, compressors, nozzles, evaporators. Limitations. Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Clausius statement, equivalence of statements, Perpetual motion Machine of first and second kind, Carnot engine.

5. Properties of Steam

Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of steam, T- s diagrams, Mollier diagram (H - S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes Quality of steam (dryness fraction), measurement of dryness fraction, throttling calorimeter.

7. Steam turbines

Function and use of steam turbine, Steam nozzles- types and applications, Steam turbines, impulse, reaction, Throttle governing of steam turbines.

6. Steam Boiler

Classification of steam Boilers, Working principle of Simple vertical boilers & babcock and Wilcox boiler, boiler mountings and accessories.

WORKSHOP TECHNOLOGY

Paper Code : 143005

UNIT-1

Principle of welding, Classification of welding processes, Advantages and limitations, Industrial applications of welding, Welding positions and techniques, symbols. Gas Welding , Principle of gas welding, Types of gas welding flames and their applications, Gas welding equipments, Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes.

UNIT-2

Arc Welding, Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes, Flux for arc welding. Other Welding processes, Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding. Shielded metal arc welding, submerged arc welding, welding defects, methods of controlling welding defects and inspection of welded joints.

UNIT-3

Modern Welding Methods, Principle of operation, advantages, disadvantages and applications of: Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding.

UNIT-4

Pattern Making, Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S. Introduction to cores, core boxes and core materials, Core making procedure , Core prints, positioning of cores. Moulding Sand , Properties of moulding sand, permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility etc. Various

types of moulding sand and testing of moulding sand. Mould Making, Types of moulds, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floor molding, pit molding and machine molding.

UNIT-5

Casting Processes Principle, working and applications of Die casting: hot chamber and cold chamber, Investment and lost wax process, Centrifugal casting, Continuous casting process. Gating and Riser system , Elements of gating system, Pouring basin, sprue, runner, gates Types of risers, location of riser, Casting Defects, Different types of casting defects and their reasons, testing of defects: radiography, magnetic particle inspection, and ultrasonic inspection.

UNIT-6

Melting Furnaces Construction and working of: Pit furnace, Cupola furnace, Crucible furnace -tilting type.

APPLIED MECHANICS

Paper Code : 143006

1- Introduction

- 1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.
- 1.2 Definition, basic quantities and derived quantities of basic units and derived units.
- 1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another density, force, pressure, work, power, velocity, acceleration.
- 1.4 Concept of rigid body, scalar and vector quantities.

2- Laws of forces

- 2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force.
- 2.2 Different force systems (coplanar and non-coplanar), the principle of transmissibility of forces, law of superposition.
- 2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components.
- 2.4 Free body diagram.
- 2.5 Equilibrant force and its determination.
- 2.6 Lami's theorem (concept only).

3- Moment

- 3.1 Concept of moment.
- 3.2 Moment of a force and units of moment.
- 3.3 Varignon's theorem (definition only).
- 3.4 Principle of moment and its applications (Levers – simple and compound, steel).

4- Friction

- 4.1 Definition and concept of friction, types of friction, force of friction.
- 4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction.
- 4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane, friction in simple screw jack.
- 4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:
 - a) Acting along the inclined plane Horizontally
 - b) At some angle with the inclined plane

5- Centre of Gravity

- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies.
- 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion.
- 5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed.

6- **Moment of Inertia**

Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical sections: rectangle, triangle, circle (*without derivations*). Second moment of area for L, T and I sections, section modulus.

7- **Simple Machines**

7.1 Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines.

7.2 Simple and compound machine (Examples).

7.3 Definition of ideal machine, reversible and self locking machine.

7.4 Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency.

7.5 System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency.

7.6 Working principle and application of wheel and axle, different pulley blocks, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application.