

Syllabus for Metallurgical Engineering Discipline (M&C)
(Diploma Level)

Metrology:

Limits, fits & tolerance, standards of measurement

Linear measurement: Vernier caliper, micrometer, height gauge, depth gauge, radius gauge, feeler gauge, dial indicators, slip gauges.

Angular measurements: Combination set, vernier bevel protractor, sine bar, taper measurement by rollers.

Surface measurement: straight edge, try square, surface plate

Surface finish measurement: of Roughness and waviness, various roughness value – CLS, rms, mean, principle of working of measuring instrument.

Thread measurement: Measurement of internal and external thread, screw pitch gauges, screw thread micrometer and thread limit gauge.

Gear measurement.

Other measuring instrument: autocollimator, Tool maker's microscope, profile projector coordinate measuring machine.

Testing of material:

Nondestructive testing: Ultrasonic testing, radiography, magnetic particle testing, eddy current testing, dye penetration testing.

Physical testing: Tensile test, % elongation, % reduction in area, hardness (Brinell, Rockwell, Vickers), impact test (Izod, Charpy), bend test, shear test, fatigue test, creep test.

Chemical testing ferrous and non ferrous metals

Metallography; micro and macro examination

Metallurgical analysis:

Sampling of raw materials and products, single and double sampling plan

Quantitative analysis: General principle and reactions of common cations & Anions

Quantitative analysis: ores and alloys of Fe, Mn, Ni, Cu, Sn, Pb, Zn, analysis of carbon steels, slag and refractories

Physico-Chemical analysis : Electrometric titration, calorimetry, absorptiometry, colourimetry, polarography, and spectrographic analysis.

Fundamentals of manufacturing processes:

Foundry technology: Pattern making sand mould making, sand testing, core making, gating and risering, melting (including pit furnace, cupola and electric furnace) and pouring solidification and cooling, finishing and inspection, special casting processes (permanent mould casting, investment casting die, casting centrifugal casting, continuous casting), casting defects

Welding : Electric arc welding, gas welding, gas cutting, resistance welding, TIG & MIG welding, thermit welding, brazing, soldering, welding defects.

Heat treatment: hardening, annealing, tempering, normalizing, surface hardening, case hardening. Hot and cold working Rolling, forging, wire & tube drawing, deep drawing extrusion

Engineering Materials :

Cast Iron: Different types of cast iron, their properties, composition and uses.

Wrought iron properties, composition and uses.

Steels: Different types of steel and classification. Properties composition and uses of plain carbon, alloy steel, high speed steel, stainless steel, spring steel.
Effect of various alloying element like Cr, Ni, Co, Mo, Mn, S on mechanical properties of steel.
Properties of Al, Cu, Zn, Sn, Pb
Composition properties and uses of duralumin, brass, bronze, gun-metal, German silver, bearing metal, constantan, solder

Material Science :

Thermal, chemical, electrical, magnetic and mechanical properties of material. Structure of metals (arrangement of atoms, crystalline & amorphous structure, crystal imperfections), solid solution, transformation during cooling of metals and alloys, deformation and metal, impact of cold and hot working on metal, corrosion, Principles of Corrosion, Different forms, causes, Measurements and prevention.

Physical metallurgy

Elasticity, plasticity, fracture and fracture toughness, fatigue, solid solutions, equilibrium diagram, thermal treatment, isothermal transformation of austenite, TTT and CCT diagrams Cooling, curves, austempering, martempering, factors affecting hardenability, function of alloying elements in steel (ferrite former, austenite former, carbide former, stabilizer)

Basic extractive metallurgy:

Important ores of Fe, Al, Cu, Zn, Sn, Pb

Beneficiation/ ore dressing (crushing, grinding, sizing, separation processes e.g. classification, flotation, electrostatic/ magnetic separation) pyrometallurgy (Drying calcinations, roasting, smelting, converting) concentration, agglomeration, reduction of metal oxide, refining process (vacuum degassing, distillation), hydro metallurgy (leaching, precipitation), electro-metallurgy (laws of electrolysis, Electrolytic Media)

Production of pig iron Blast furnace operation, coke, slag, flux

Production of steel Bessemer converter, L.D. process, open hearth process, electric arc furnace process, ingot casting and defects, VAD process

Production of ferro silicon, ferro manganese alloys and ferro chrome

Powder metallurgy Production process, characteristics of powder, pressing and sintering, advantages and application.

Fuels furnaces and refractories:

Principles of heat transfer conduction, convection radiation

Fuel: comparative study of solid, liquid and gaseous fuels, producer gas, water gas, specification and testing of fuel oils, Coal: Constituents of coal, selection of coal for metallurgical purposes, washing of coal, sizing, cleaning, gravity, concentration, jigs, tables, hydrotators, launders, flotation, pneumatic method, de-watering, drying surface preparation, storage.

Furnace: furnaces classification and principle of furnaces used in metallurgical industries. Refractories, Classification of refractories (acid basic neutral) important physical and chemical properties, testing. Pyrometry Thermoelectric Pyrometer, thermocouple resistance thermometer, optical pyrometer, total radiation pyrometer.

Metallurgical thermodynamics and kinetics:

Exothermic and endothermic reactions, enthalpy, Hess's Law, Kirochoff's law, first law of thermodynamics entropy, second law of thermodynamics, Gibbs equations, free energy thermodynamic potentials equilibrium, law of mass action, equilibrium rate of reaction, solutions. Roul't's law, Ideal and real solutions. Henry law, activity coefficient, choice of standard state, electrolytes, electrode potential chemical and electrical energy references electrodes, polarization, electro deposition of metal and alloys, the Nerst equation, calculation of EMF, Faraday's law of electrolytes, current efficiency, current density. phase rule applications to systems, absorption and absorption diffusion.

Metallurgical design

Heat transfer in metallurgical process Conduction convection, radiation, flow, blast, draft Heating furnaces: classification, design of fuel hearth, flues and passages, material handling, design of arc roof, estimation of heat losses, heat balance, fuel requirement Electric furnaces: Design of heating element in resistance furnace, efficiency and performance of induction and arc furnace Elements of cupola design, blast furnaces.

