

CERAMICS TECHNOLOGY**Group code: CR****Total Marks: 100****UNIT 1: Ceramic Raw Materials.****1x20=20 Marks**

Introduction to geology, branches, importance and scope of geology, solar system, formation of earth, its parts, age of earth and types of atmosphere.

Mineralogy: Definition, physical properties (habit, color, streak, crystal system, luster, cleavage, fracture, hardness, specific gravity, magnetic property) of different minerals (quartz, feldspar, dolomite, gypsum, graphite, talc, zircon, bauxite, corundum, chromites).

Petrology: Definition, classification, formation, of igneous, sedimentary & metamorphic rocks (granite, diorite, basalt, hornblende, obsidian, pegmatite, syenite, Gabor, dolerite, peridotite), sedimentary (conglomerate, dolomite, limestone, sandstone, shale, laterite, rock salt, chert, breccias) and metamorphic rocks (marble, slate, soapstone, quartzite, gneiss, phyllite, schis, amphibolite) with their uses.

Crystallography: Definition of crystal, elements of crystal, crystallographic axes, axial & symmetry character, interfacial angle, crystal system.

Clay: definition, formation, classification, properties, impurities & its purification and its use in ceramics.

Source, properties and uses of Silica, Alumina, alumino silicates, feldspar, dolomite & magnasite.

Definition, preparation, properties and uses of carbides, nitrides, borides, silicides, SiAlON's, Cermets, Spinel, Zirconia, Foresterites and industrial diamonds.

Additives: Properties and uses of various mill additives like plasticizer, binder, electrolytes, foaming, antifoaming agents, surfactants, lubricants, organic liquids.

UNIT 2: Manufacturing Process.**1x10=10 Marks**

Size reduction, reduction ratio, factors affecting efficiency, crushers, grinders, separators, mixers, conveyors, shaping equipments, driers with their classification, construction & working.

Definition of furnace, their classification, construction and working. Draughts, type of draughts, burners and its types, importance of firing, firing schedule, firing atmosphere & kiln furnitures.

Definition, classification, properties and uses of solid, liquid & gaseous fuels. Operation and uses of pyroscopes and pyrometers.

UNIT 3: Ceramic Coatings & Products**1x20=20 Marks**

Ceramic Coatings: definition, raw materials, batch preparation, classification of glazes, application methods and properties of glazes and enamels. Definition of frit, need of fritting,

requirements of frit, fritting process. Simple calculations on moisture content, LDS, VDS, density, porosity, water absorption, suspension problems, MOR and tensile strength.

Traditional Ceramic wares: definition, manufacturing, properties and uses of terracotta, earthenware, stoneware and porcelain.

Advanced Ceramic Wares: definition, manufacturing, properties and applications of electronics ceramics (capacitors, piezo ceramics, sensors, thermistors, varistors, Lasers), Ferrites, wear resistant wares (grinding wheel, cutting tools, grinding media, bearings, thread guides), bioceramics, composites and glass ceramics.

UNIT 4: Glass Technology.

1x15=15 Marks

Definition, classification, properties and application of glass. Raw material classifications, material selection, purification, melting of batch in pot and tank furnace, need of regenerators and recuperators, refining, gob feeding devices, moulds (wooden, carbon, cast iron, paste, brass), fabrication method (blowing, pressing, rolling, drawing, spinning, float), annealing, testing (density, viscosity of glass, Electrical properties: electric conductivity, Thermal properties: thermal expansion, specific heat, heat conductivity, thermal endurance, Mechanical properties: young's modulus of elasticity, tensile strength, modulus of rupture (MOR), bursting pressure, crushing strength, Optical properties- refractive index, dispersion, absorption of light, transparency) and defects (colour, seeds, chord, stones, blisters, bulging and neck-ring in bottle glass) in glass.

UNIT 5: Cement technology.

1x10=10Marks

Definition, types, properties and uses of various cements (OPC with 33, 43 & 53 grades, Blended cement: Portland Pozzolona cement, Portland slag cement, White cement, Sulphate resisting cement, Oil well cement, Rapid hardening Cement, High alumina cement, Low heat cement, quick setting Cement, hydrophobic cement and IRS-T special grade Cement). Manufacturing: Raw materials, batch preparation, burning in rotary kiln, clinker grinding in ball and tube mill. Phases of cement (C_2S , C_3S , C_3A , C_4AF), hydration of cement, Tests on cement (Normal consistency, IST, FST, CCS, Soundness by Le-chatelier's and autoclave method and Fineness by Blains air permeability method) and safety precautions in cement industry.

UNIT 6: Refractories.

1x15=15 Marks

Definition, classification based on chemical nature and working temperature, specific properties of each refractory (Fireclay, silica, MgO, Mag-Chrome, Chrome-Mag, dolomite, carbon, chromite, alumina) with their field of application. Manufacturing and testing (PCE, RUL, PLCR, Slag Resistance, thermal conductivity) of refractories. Definition of phase rule, binary and ternary systems in phase equilibrium.

Production of iron and steel with different methods and flow diagram (blast furnace, Corex process, Finex process). Construction and working of blast furnace, with refractories in different parts of blast furnace like Hearth part (Carbon refractories of different varieties), Bosh &

Belly (Alumina/ SiC), stack (Alumina / Graphite), furnace top (Alumina), Uptake, down comers (gunning/ casting with high alumina conventional castables) & cyclones (High Abrasion Alumina based), Hot blast main, Bustle main, Hot blast stoves, ceramic burners (alumina based), Blow pipes (self flow castables Al / Al. ZrO₂).

Define one heat, functions, schematic diagram, refractories used for Transfer ladles, lances, steel ladle with its parts (slide gate, purging plug), LD convertor, RH degasser with parts (snorkel). Process study of hot metal de-sulphurisation, reagents used, measuring refractory thickness. Role of caster in steel making process, black refractories (SEN, SHROUD, MBS), tundish refractories.

UNIT 7: Management

1x10=10 Marks

Management-Henry Foyal's principles-organization types- Production and Productivity- Product Design and its Stages- Types of Production- Functions of Production- Planning and Control Department- Purchasing and its Procedure- methods of purchasing - Comparative statement-purchase order-Tender-Types of tender

Storekeeping- classification of stores - Functions of store keeper -Bin Card - Material Issue Requisition- Material Returned Note- Store ledgers. Inventory Management- Definition - functions of Inventory Control

Material Requirement Planning (MRP)-concept, applications -Just in Time (JIT)-concept enefits – FIFO(first in first out) concept-advantages.

Motivation-Leader and types-Logistics- Quality- Factors affecting quality Inspection-Types.

Total Quality Management-Meaning- Principles of total quality management-PDCA cycles- Quality Circles-definition-Function.

TQM Tools- Flow charts, Control charts, Histograms, Pareto charts, Cause and effect diagram-5-S- Kaizen, and Six-sigma

Quality Certification Systems- ISO 9000 series quality standards, QS14000– ISO 9000, ISO 9001,ISO9002,ISO9003 & ISO 9004- ISO9000 quality certification procedure.

Plant maintenance-Definition-Types of maintenance-Preventive maintenance- Break down maintenance.

Industrial safety –Meaning - Accident- causes for accident- Direct and indirect losses due to an accident- Safety department- role of safety officer

Environment - Definition and scope-Solid waste management- causes, effects and control measures of municipal solid wastes (hospital wastes, hazardous wastes and e-wastes)- Water conservation and rain water harvesting. Climate change- global warming, acid rain, ozone layer depletion