

## Detail Syllabus of 3<sup>rd</sup> Year Odd Semester B.Sc. Engineering

### GCE3511 (Physical Ceramics)

*Lecture: 3 hrs/week, No. of Credit: 3.00*

**Ceramic Phase Equilibrium Diagrams:** Techniques for determining phase diagrams, One-, two-, and three- components phase diagrams, Phase composition versus temperature, Typical ceramic systems, Nonequilibrium phases.

**Optical Properties:** Absorption, Transmission, Scattering, Refraction and Reflection, Refractive Index and Dispersion, Boundary Reflectance and Surface Gloss, Opacity and Translucency, Color in ceramic, Applications.

**Electrical Properties:** Electrical–conduction phenomena, Ionic conduction in crystals, Electronic conduction in crystals, Ionic conduction in glasses, Electronic conduction in glasses, Nonstoichiometric and Solute-controlled electronic conduction, Valency-controlled semiconductor, Mixed conduction in poor conduction, Polycrystalline ceramic.

**Dielectric Properties:** Dielectric constants, Conductivity and Strength, Dielectric loss and breakdown, Loss factor, Equivalent circuit description of linear dielectrics, Power factor, Dielectric polarization, Polycrystalline and Polyphase ceramic, Ceramic capacitors and insulators, Ferroelectric ceramic.

**Magnetic Properties:** Diamagnetism, Paramagnetism, Pauli paramagnetism, Ferromagnetism, Antiferromagnetism and Ferri magnetism, The origin of interactions in ferromagnetic materials, Soft & Hard magnetic materials, Spinel Ferrites, Rare earth garnets, Ortho ferrites and Ilmenites, Hexagonal Ferrite, Polycrystalline Ferrite.

**Thermal Properties:** Heat capacity, Density and Thermal expansion of crystals, Thermal expansion of composite bodies, Thermal conduction process.

### GCE3513 (Physical Metallurgy)

*Lecture: 3 hrs/week, No. of Credit: 3.00*

**Ferrous Metal:** Allotropic transformation and Cooling curve of pure iron, Phase diagram of Iron-Iron Carbide, Different Phases and Structures, Classification of Steel and Cast iron.

**Alloy Steel:** Purpose of alloying, Effect of alloying elements, Stainless steel: Different types of stainless steel, Their formation and microstructure.

**Tool Steel:** Definition, Classification: Water Hardening, Shock Resisting, Cold Work, Hot Work, & High Speed Tool Steel, Cutting Tool.

**Heat Treatment of Steel:** Different heat treatment processes, Isothermal transformation diagram, Mechanism of heat removal during quenching, Quenching medium and temperature.

**Case Hardening:** Carburizing, Cyaniding, Carbonitriding, Nitriding, Flame Hardening, Induction Hardening.

**Non-Ferrous Metals and Alloys:** Copper and Copper alloys- Brass and Bronze, Aluminum and Aluminum alloys, Precious metals, Bearing metal.

**Powder Metallurgy:** Significance and Importance, Processes, Supplemental operations, Designs of P/M parts, Applications.

### GCE3515 (Refractories)

*Lecture: 3 hrs/week, No. of Credit: 3.00*

**Introduction:** Refractoriness, Scope of refractory materials in industry-Global and Domestic market scenario, Application of refractories.

**Types, Manufacturing and Applications of Refractories:** Monolithic refractories, Fireclay refractories, Silica refractories, Super duty, Semi silica refractories, High Alumina and Alumino

Silicate refractories, Basic refractories, Non Clay refractories, **Fusion cast refractories**, Non Oxide refractories, Carbon bearing refractories, Insulating refractories, Special refractories. Production of burnt refractories - Sintered and **Fused refractories**: - Chemically bonded and Direct bonded.

**Properties and Testing of Refractories:** Apparent Porosity, Bulk Density, Modulus of Rupture (MOR), Hot Modulus of Rupture, Cold Crushing Strength, Spalling Resistance, Pycnometric Cone Equivalent, Thermal Expansion, Thermal Expansion Under Load (TEUL) and Creep, Thermal Conductivity, Chemical analysis, Advantages and Disadvantages of different refractories.

**Phase Equilibrium in Refractory Materials:** Binary and Ternary system of  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$ ,  $\text{CaO}$ ,  $\text{FeO}$ ,  $\text{MgO}$ ,  $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$  System.

**Selection of Refractories:** Considerations during Selection of refractories, Use of refractories in different industry.

### **GCE3517 (Engineering Materials)**

*Lecture: 3 hrs/week, No. of Credit: 3.00*

**Superalloys:** Concept of superalloys, Importance, Basic alloying features, Strengthening mechanisms in superalloys, Alloy design and processing to improve performance, Nickel-based superalloy, Dispersion-hardened superalloys.

**Semiconductors:** General concepts, Different types of semiconductors, Applications.

**Polymeric materials:** Classification, Polymerization reaction, Structure and Properties, Processing and Application.

**Biomaterials:** Basic concepts, Different types of biomaterials, Applications.

**Composite materials:** General concepts, Design of composite materials, Carbon-carbon composites, Metal matrix composite, Ceramic matrix composite, Polymer matrix composite, Application of composites materials.

**Handling, Transportation and storage of Engineering Materials:** Concepts of materials handling, Unit load handling, OSHA safety requirements, Materials handling safety and training, Store management and operation

### **IPE3531 (Quality Control)**

*Lecture: 3 hrs/week, No. of Credit: 3.00*

**Introduction:** Definition of quality, Quality control, Quality assurance, TQM, Quality circle. Importance of quality control activities in an organization, Quality loop in an organization, Stages of quality control activities in an organization, Type of quality characteristics, Advantages & disadvantages of different quality characteristics.

**Statistical Process:** Definition, Chance causes, Assignable causes, Difference between two causes.

**Cost of Quality:** Elements of quality cost, Assessing cost of quality, Cost of appraisal, Prevention & failure cost, Optimum cost of quality control, Quality cost awareness.

**ISO-9000/Quality System:** Introduction, Definition of ISO, Its development, Series of ISO - 9000 standards, Selection of standards, Classes of ISO - 9000 quality system, Benefits of ISO - 9000 quality system.

**Seven Tools of Quality Control:** Cause & effect diagram, Scatter diagram, Control charts, Pareto diagram, Histogram, Flow charts, Graph check sheets.

**Process Capability Study:** Definition, Needs of process capability study, Derivation of standard deviation, Concept of USL & LSL, Six sigma, Accuracy & precision, Calculation of  $C_p$  &  $C_{pk}$  indices, Implication of  $C_p$  &  $C_{pk}$  on process control.

**Process of Continuous Improvement:** Quality circle--Definition, Basis of Q.C. circle, Starting of a Q.C. circle, Kanban system, PDCA cycle, Brain storming, Cause & effect diagram, Gantt chart.

**Packaging:** Packaging materials, load testing procedure of packages.

**GCE3508 (Materials Characterization Sessional)**

*Sessional: 3 hrs/week, No. of Credit: 1.50*

Sessional based on **GCE2407**

**GCE3512 (Physical Ceramics Sessional)**

*Sessional: 3 hrs/week, No. of Credit: 1.50*

Sessional based on **GCE3511**

**GCE3514 (Physical Metallurgy Sessional)**

*Sessional: 1.5 hrs/week, No. of Credit: 0.75*

Sessional based on **GCE3513**

**GCE3516 (Refractories Sessional)**

*Sessional: 3 hrs/week, No. of credit: 1.50*

Sessional based on **GCE3515**

To be arranged in any suitable time in **3<sup>rd</sup> year**.