Department of Metallurgical& Materials Engineering
National Institute of Technology Srinagar

Syllabus for Ph.D MMED

MATERIALS TECHNOLOGY

An introduction ton Metallurgy ad Classification of Metallurgical Processes. Classification of Engineering Materialsbased on Engineering properties. Introduction of Nano-technology (Its importance and application). A brief discussion on important ferrous and non-ferrous materials and their production processes (flow sheets giving important parameters). A general discussion on other engineering materials plastics, rubber, polymer, ceramics, Refractories glasses, composites etc. Phase rule and phase diagrams (Binary system). A discussion on iron carbon equilibrium diagram and the critical phenomenon, Bonding in solids, crystal structure & imperfections. Elasticity, plasticity and strength of materials. Plastic deformation in single crystals. Slip and Twinning mechanism. Critical resolved shear stress. Strain hardening, recovery, recrystallization and grain growth, Single crystals, polycrystalline materials and factors affecting their mechanical properties. Yield strength, tensile strength and rupture strength. Ductility and malleability, toughness and hardness of materials.

Free electron theory. Metallic conduction and factors affecting conductivity, semi conductor materials and techniques or processing semi conductors, oxidation diffusion, ion and electron beam, ion implantation. Plasma technology etc. MOS,MNOS and SOS etc. technologies. Gas I.C. technologies etc. Doping, Hall effect, p-n junctions etc. Ionic and super-ionic conduction, single crystal growth.

Magnetic material: dia, para, ferro, ferri, antiferro, ceramic magnetic material. Magnetism, theory of magnetism, Hard and soft Magnetic materials, their classification and application, technology of their production, precipitation hardening magenetic alloys, permanent magnetic materials.

Di-electronic materials, Piezo, and ferro electric materials, doping and electric breakdowns, ferrites transformer and switching materials, optical properties lasers etc .

Corrosion:

Importance of the study of corrosion and its economic impact.

Different forms of corrosion and their control viz., uniform corrosion, galvanic corrosion, selective leaching, crevice corrosion, filiform corrosion, pitting corrosion, intergranular corrosion, erosion corrosion, fretting damage, stress corrosion cracking, corrosion fatigue, and hydrogen embrittlement. Thermodynamics and kinetics of corrosion, passivation, mixed potential theory of corrosion and its application to understand the influence of oxidizers, effect of velocity of the medium, galvanic corrosion: area relationship in both active and passive states of metals.

Elementary treatment of corrosion testing procedures, inhibitors and corrosion of steels.

High temperature gaseous reaction (dry): single metal-single oxidant systems, aspects of thermodynamics, kinetics, transport properties, scale morphologies, electrochemical emphasis, various forms of high temperature corrosion.

Powder Metallurgy:

Powder fabrication methods: preparation of metallic, ceramic and composite powders

Powder Characterization, pre-compacting processes, mixing, milling, lubricant addition etc.; Shaping and compaction: density and stress distribution, defects during compaction, alternative methods of producing shapes. design rules, behavior of powder during compaction, uniaxial and isostatic compaction, extrusion and forging, roll compaction, injection moulding, tape forming, slip casting and sol-gel casting.

Sintering and full density processing: ; Sintering - furnaces and atmosphere, phenomenology of sintering, evolution of microstructure, stages and mechanism of sintering, desintering; sintering of mixed powders, liquid phase sintering; activated sintering, reaction sintering, hot consolidation of powders, post-sintering treatments; Applications - structural parts, cemented carbides, structural ceramics and composites.

Properties of P/M materials: effect of porosity and alloying, Applications of P/M materials

Syllabus for (Ph.D Entrance Examination)Session: Spring-2016

Process Metallurgy

Laws of Thermodynamics Carnot cycle, Gibb's- Helmholtz equation, chemical potential, Ellingham diagram, Gibb's – Duhem equation. Raoult's, Henry's and Sievert's Laws, mixing excess functions, Alternative standard state, Regular solutions, Classius-Clapeyron Equation, Statistical Thermodynamics, Miscibility gap.

Chemical kinetics and its related laws, theories of reaction rates and reaction mechanism, concept of activation energy. Diffusion in solids, Fick's laws and Kirkendall effects, heterogeneous equillibria and introduction to mass transfer.

Blast furnace iron making, physic- chemical principles, aerodynamics, direct and indirect reduction, degree of reduction and degree of metallization, Modern developments, productivity. DRI (Direct Reduced Iron) and principles of ferro alloy making.

Steel making, desiliconisation and desulphurization of pig iron. Primary and secondary steel making, physico- chemical principles, deoxidationand vacuum treatment of steels, continuous casting and alloy steelmaking.

Composites, polymer-metal- ceramic types, isostress and isostrain loading conditions, U/D composites, mathematical modelling, prepreg-preform conditions, wet and way layout methods, pultrusion and filament winding processes. Conventional composites, wood and concrete. Plastics- RP-FRP-A/C/GFRP, airbus-320, nano satellite, boat hulls, helicopter hubs, submarine composite materials.

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Syllabus for Syllabus for Foundry Technology

(Ph.D Entrance Examination) Session Spring-2016

Engineering materials and their properties,Crystal structure and imperfections structure property relationship,Stress strain curves for different engineering materials,Deformation of metals/alloys, Hardening methods,Effect of different parameters on the yielding of materials and their properties, Fatigue and creep behavior of metals, Metal working processes, Rolling, Forging, Extraction etc.Non conventional forming methods.Fracture and failure analysis,Destructive and Non-destructive testing,

1. Moulding Sands: Testing and Binders

2. Core Sands: additives

3. Pattern materials: Types, allowances and design considerations

4. Moulding Techniques

5. Gatting and feeding systems of casting.

6. Melting Furnaces

7. Principles of solidification:

   Fluid flow and heat flow in solidification, single phase and multiphate metals and Alloys, structure, and properties, of solidification of castings and ingots, progressive and directional solidification, nucleation and growth

8. Special casting methods such as shell mould casting, cosmould casting, centrifugal casting etc.

9. Casting defects for their control.