MTT- 601 Engineering Materials **2L - 1T – 0P/3Cr**

Ferrous alloys as engineering materials. Steel for automotive, building, naval and structural applications. High performance steels.
New generation cast irons for engineering application.
Aluminium alloys as engineering materials for aerospace, automotive and off shore applications.
Materials for polar engineering.
High conductivity materials-----Copper and its alloys; Aluminium as conductivity material.
Light alloys for engineering applications as Aerospace, Automotive and Bio materials.
Ceramic materials:
Structural properties of ceramics and structural, dielectric, ferroelectric and semiconductor materials, tough ceramics, bio ceramics and electro ceramics.
Polymeric Materials:
Review of polymers as engineering materials
High temperature polymers, conducting polymers, elastomers as engineering materials.
Polymers in biomolecular engineering. Use of polymers in membranes technology.

Composite materials:
Nano composites. Intermetallic matrix composites as engineering materials.
Selection of engineering materials------it's rationals.

References:

1. Introduction to Metallurgy – A. H. Cottrell
2. Selection and use of Engineering Materials –J.A. Charles, F.A. Crane, and J.A. Furness
3. Engineering Materials: Polymers, Ceramics and Composites—A.K. Bhargava, II Edition, PHI Learning Pvt. Ltd., N. Delhi
4. Engineering Materials – M.F. Ashby and D.R.F. Jones, Vol. 1 & 2
5. Smart Materials and New Technologies – D.M. Addington and D. L. Schodek.

MTT- 603 Manufacturing Processes **2L - 1T – 0P/3Cr**

Introduction to mechanical working, Principles of mechanical working, Classification of working processes.

Extrusion: Classification of extrusion processes, variables in extrusion, Extrusion equipment, Hydrostatic extrusion, Impact extrusion, Defects in extrusion.

Forging: Classification of forging operations, E.R. Frost rules, Forging equipment and forging defects.

Rod and Wire drawing: Classification of steel wire, Variables in wire drawing, Wire drawing equipment, Petenting, Defects in wire and rod products.

Rolling: Forces and Geometrical relationship in rolling, Classification of rolling mill, Variables in rolling, Roll pass design, Types of passes, Rolling defects.

Sheet metal forming: Classification of forming operations, defects in formed products, High energy forming, and classification of high energy forming.

References:

1. Mechanical Metallurgy—George E. Dieter, McGraw Hill
2. Introduction to Manufacturing Processes – - John A. Schey, McGraw Hill
3. Manufacturing Processes for Engineering Materials – Serope Kalpkjian and Steven R. Schmid, Pearson Education Asia
4. Manufacturing Processes -- Kaushish, PHI Learning Pvt. Ltd., N. Delhi.
5. Metal Fabrication Technology – Mukherjee, PHI Learning Pvt. Ltd., N. Delhi
6. Modern Materials and Manufacturing Processes—Bruce, III Ed., Pearson

MTT- 605 Metallurgy of Secondary Steel Making 2L - 1T – 0P/3Cr

Steel making fundamentals: Thermodynamics, Role of slag in steel making, physico-chemical properties of slags, Oxidation reaction: iron ,silicon, decarburization and manganese oxidation, Dephosphorisation reaction. Desulphurisation of steels.

Modern steel making practice: Steel making in electric arc furnace; design and operation, developement in electric furnace steel making, DRI in electric steel making, alloy steel making, Novel steelmaking technologies: CONARC and EOF.

Ladle metallurgy: Evolution of ladle treatment and requirements, synthatic slag practice, principles of deoxidation. Deoxidation practice, principles of degassing. Degassing technologies. clean steel production; impact of inclusions on properties of steel.

Deep desulphurisation and deep dephosphorisation in secondary steel making. Continuous casting of steel.

Reference:

1. Steel Making – R. J. Ward
2. Physical Chemistry of Iron and Steel Making – Bodsworth
3. Iron Making and Steel Making – Amit Chatterjee and Ahindra Ghosh
4. Steel Making – A. K. Chakraborty
5. Electric Arc Furnace Steel Making – Iron and Steel Society Editor C. R. Taylor

MTT-607 : Nanomaterials : Processing and Properties

2L - 1T - 0P/3Cr

Introduction to nanomaterials, properties of materials & nanomaterials, role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells, conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state.

Fabrication of nanomaterials by physical methods: -Inert gas condensation, Arc discharge, Plasma arc technique, RF plasma, MW plasma, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Molecular beam epitaxy, Chemical vapour deposition method and Electro deposition.

Chemical routes for synthesis of nanomaterials: Chemical precipitation and coprecipitation, metal nanocrystals by reduction, sol-gel synthesis, microemulsions or reverse micelles, micelles formation, thermolysis routes, electrochemical synthesis; chemical bath deposition, synthesis in supercritical fluids.

Self assembly and catalysis: Process of self assembly, semiconductors islands, monolayers, nature of catalysis, porous materials, pillared clays, colloids, and biometrics.

Characterization: X-ray diffraction, scanning electron microscopy (SEM), scanning probe microscopy (SPM), TEM and EDAX analysis, scanning tunneling microscopy (STM), atomic force microscopy (AFM), UV-VIS-IR spectrophotometers, Principle of operation and application for band gap measurement, raman spectroscopy, X-ray photoelectron spectroscopy (XPS).

Nanocomposites: Metal-Metal nanocomposites, Polymer-Metal nanocomposites, Ceramic nanocomposites: Dielectric and CMR based nanocomposites. (One example for each type).

References:

1. Novel Nanocrystalline Alloys and Magnetic Nanomaterials- Brian Cantor
2. Nanoscale materials -Liz Marzan and Kamat
3. Springer Handbook of Nanotechnology - Bharat Bhusan
4. Nanostructures and Nanomaterials - Synthesis, Properties and Applications - Cao, Guozhong
5. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM - Ray F. Egerton
6. Nanoscience & Technology: Novel structure and phenomea by Ping Sheng (Editor)

MTT- 609 COMPOSITE MATERIALS 2L - 1T - 0P /3Cr

Definition, importance of composite materials over other engineering materials; advantages and disadvantages of composites; general characteristics, general requirements of composite materials. Classification of composites on the basis of microstructure, reinforcement geometry and matrix materials.

Forms of reinforcements, their function and characteristics. Functions of matrices and their characteristics.

Dispersion strengthened, particle strengthened and fibre-reinforced composites. Strengthening mechanisms, Rule of mixtures. Continuous and discontinuous fibre composites.

Major composite classes – polymer matrix, metal matrix and ceramic matrix composites. Hybrid composites. Examples of these composites. Role of interfaces in composites. Toughening mechanisms in PMC, MMCs and CMCs. Fabrication of fibre reinforced composites.

Laminated, sandwich and filled composites: Applications of composites.

References:

1. Composite Materials: Properties, Non-destructive testing and repair by Mel M. Schwartz, Pub: Prentice Hall, New Jersey.
2. Industrial Materials: Polymers, Ceramics and composites, Vol. 2 by David A Colling and Thomas Vasilos, Pub.: Prentice Hall, N. Jersey.
3. Modern composite Materials by L.J. Broutman and R.M. Krock Pub.: Addison-Wesley.
4. Composite Materials – Science and Engg. By K.K. Chawla, Pub.: spriger-Verlag, New York.
5. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall.
6. Engineering Materials: Polymers, Ceramics and Composites – A. K. Bhargava, PHI Learning Pvt. Ltd. N. Delhi