Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-401	Course Name: Physical Metallurgy of Non-Ferrous Metals & Alloys
Credit:4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

The course will deal with the metals: Copper, Nickel, Aluminium,Lead, Zinc, Tin, Magnesium and Titanium and their alloys Physical, (Electrical, Thermal, Magnetic) and Mechanical (Hardness & Strength) Properties of pure metals, Classification and designation of the alloys of the above metals. Typical characteristics of these alloys.

Important heat treatment practices of the alloys, Corrosion behaviour of these metals and alloys. Applications of these metals & their alloys.

Books:

1. Metals Hand Book Vol.2 10th edition.
2. Physical Metallurgy - Vijendra Singh
3. Introduction to Engineering Materials - B.K. Agarwal
4. Physical Metallurgy - Sidney H. Avner
5. Physical Metallurgy & Heat Treatment - Lakhtin
6. Heat Treatment – T.V.Rajan

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code: MTT-403	Course Name: Experimental Techniques
Credit:4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Vacuum techniques: Methods of producing vacuum, characteristics of mechanical and diffusion pumps, Techniques of measuring vacuum, mercury manometers, electrical gauges, etc. Thermal methods: Thermal analysis of phase transformation by conventional thermal methods, namely, direct cooling curves, inverse rate cooling curves, differential scanning calorimetry and differential thermal analysis. Dilatometric methods: Thermal expansion and volume changes associated with phase transformation, principles of mechanical and optical dilatometers, differential optical dilatometers. Resistometric studies: Electrical properties of metals and alloys, Effect of structure and composition on resistivity, Defect studies in age hardening alloys, orders-disorder transformation studies, effect of tempering on the resistivity of quenched steel. X-ray diffraction techniques: Powder method (Debye Scherrer camera). Determination of structure by XRD. Concept of reciprocal space and Ewald sphere. Electron Metallography: Principles of transmission and scanning electron microscopy, construction and working of transmission electron microscope (TEM), specimen preparation for TEM. Image formation, Selected area diffraction (SAD), Bright and dark field images. Field ion microscopy and Electron probe microanalysis.
Quantitative metallography

Books:

1. V.T. Cherepin and A.K.Malik, Experimental Techniques in Physical Metallurgy, Asia Pub. House.
2. Gareth Thomas, Transmission electron microscopy of metals, John Wiley & Sons, Inc. N.Y.
3. Gareth Thomas and Michael A. Goringe, Transmission electron microscopy of materials, John Wiley & sons, Inc. N.Y. and London.
4. Weinberg, Tools and Techniques in Physical Metalurgy.
5. B.D. Culity, Elements of X-ray diffraction.
6. R.E. Smallman and K.H.G. Ashbee, Modern Metallography,Pergamon Press

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-405	Course Name: Fracture and Failure
Credit:4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Types of fracture, Modes of fracture, Fracture toughness,Environmental effect on fracture, Fractography.Definition and explanation of the term failure, Fundamental causes of failure.Failure by fatigue, creep, wear and corrosion.Failure due to faulty selection of materials, heat treatment, and faulty selection of forming process.

Failure due to presence of chemical inhomogeneity, nonmetallic inclusions, gaseous elements, impurity elements, residual stresses.Failure due to casting defects, metal working defects, metal joining defects and poor surface finish.

Books:

1. Colangelo, V.J., Heiser, F.A., Analysis of Metallurgical Failures,John Wiley & Sons, Singapore.
2. Felbeck, David K., Atkins, Anthony G., Strength and Fracture of Engineering Solids, Prentice Hall, Inc., Englewood Cliffs.
3. Dieter, George E., Jr; Mechanical Metallurgy, McGraw Hill Book Co., New York.
4. Naumann, F.K., Failure Analysis-Case Histories and Methodology,ASM, Metals Park, Ohio.
5. American Society for Metals, Metals Handbook, 8th Ed., Vol. 10,Failure and its Prevention, ASM, Metals Park, Ohio.
6. Knott, J.E., Fundamentals of Fracture Mechanics, Butterworths,London.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code: MTT-407	Course Name: Composite Materials
Credit:4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Definition of composite materials. Advanced composites, Importance of composites over other materials. Advantages and general characteristics of composite materials, General requirements of composite materials.

Classification of composites on the basis of reinforcement and matrix, form and functions of reinforcement, Functions of matrices.Dispersion strengthened, particle strengthened and fibre-reinforced composites. Strengthening mechanisms-rule of mixture, discontinuous and continuous fibre composites. Comparison of above composites.Characteristics and materials of reinforcements and matrices.Major composite classes: polymer matrix, metal matrix, ceramic matrix, carbon-carbon, and intermetallic composites. Hybrid composites, Laminated composites. Examples of each class of composites.Role of interfaces in composites, Toughening mechanisms in PMCs,MMCs, and CMCs.Fabrication of fibre reinforced plastic and metal matrix composites. Applications of composites.

Books:

1. Mel M. Schwartz, Composite Materials: Properties, Non-destructive testing and Repair, Prentice Hall, New Jersey
2. L.J. Broutman and R.M. Krock, Modern Composite Materials,Addison-Wesley, 1967
3. K.K. Chawla, Composite Materials – Science &Engg., Springer-Veslag, New York, 1988.
4. David A.Colling& Thomas Vasilos, Industrial Materials: Polymers, Ceramics and Composites, Vol. 2, Prentice Hall, N. Jersey, 1995.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-409	Course Name: Pollution and Environmental Management in Metallurgical Industries
Credit: 4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Sources and classification of pollutants, Meterological factors influencing air pollution, Control of air pollution by equipments.Cleaner Production (Pollution Control) in Metallurgical Industries,Iron and Steel and Non-ferrous Metals (Cu, Al, Zn, and Pb), Pollution Control in Ferrous & Non- ferrous Foundries.Introduction to need of environmental management. Policies,procedures and resources for implementing and maintaining effectiveenvironmental management in the organization. ISO 14000.

Books:

1. Dust & Fume Generation in the Iron & Steel Industries, S.Andoneyev, O. Filipyev.
2. Air Pollution, M.N.Rao, HVN Rao
3. Environmental Engineering, G.N.Pandey.

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Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-411	Course Name: Industrial Ceramic Materials
Credit: 4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Properties of ceramics, some specific crystal structures, spinel,garnet, perovskite structure.Ceramic raw materials, Methods of ceramic powder processing,pressing, casting and plastic and other forming processes, sintering/firing of ceramics.Mechanical behaviour of ceramics. Ceramic toughening viz.transformation toughening, microcrack toughening, etc.

Structural ceramics: Properties and uses of oxide and non-oxide structural ceramics such as aluminia, aluminium nitride, boron nitride, tungsten carbide, titanium carbide, silicon carbide, sialon, etc.

Electromagnetic behaviour of ceramics-ceramic dielectrics, ceramic semiconductors, piezoelectric ceramics, ferroelectric ceramics, and magnetic ceramics.Properties and applications of ceramics as piezoelectrics, magnetics,dielectrics, ferroelectrics, and semiconductors.Ceramic cutting tools: Properties and applications of ceramic cutting tools such as alumina tools, boron nitride tools, silicon nitride tools,cemented carbide tools, sialon, etc. ceramics for other tools.

Books:

1. David W. Richerson, Marcel Dekker, Modern Ceramic Engineering Inc. New York
2. P. Ramakrishnan, Editor, Advanced Ceramics, Oxford & IBH Publ.Co. P.Ltd., New Delhi
3. W.D. Kingary, Introduction to Ceramics, John Wiley Sons.
4. Michel Barsoum, Fundamentals of Ceramics, McGraw Hill International Edn.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-413	Course Name: Rapid Solidification and Mechanical Alloying
Credit:4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Rapid solidification: Non-equilibrium solidification, processing techniques, mechanical, magnetic and corrosion properties of RSP products, and their properties.Mechanical alloying: Historical background & benefits of mechanical alloying; The process: factors affecting & mechanism involved,process control agents, energy transfer & energy maps. General applications: Dispersion strengthened super alloys, aluminium base materials, amorphous &nanocrystalline materials.

Books:

1. P.R.Soni – Mechanical Alloying, Fundamentals & Applications.
2. T.R.Anatharaman – Metallic Glasses

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-415	Course Name:Automotive Materials
Credit:4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

High strength to weight ratio materials for chasis and body etc. , materials for piston and cylinder assembly, materials for transmission gears, shaft, cams and valves, materials for heavy duty springs, materials for different types of bearing, materials for radiator assembly

Books:

1. Pickering, Physical Metallurgy of steels.
2. Leslie, Physical Metallurgy of steels.
3. Honey comb, Physical Metallurgy of steels.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-417	Course Name:Surface Coatings
Credit:4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Importance of coatings and the basic requirements of a coating.Properties and methods of application of metallic coatings, organic coatings and linings, phosphate conversion coatings, chromate conversion coatings, anodising, diffusion coatings, CVD/PVD coatings, thermal spray coatings and ceramic linings.Surface pretreatment for ferrous & non-ferrous metals &alloys.Testing& evaluation of coatings. Criteria for choosing a particular coating for industrial applications

Books:

1. Science & Technology of surface coatings by Chapman and Anderson
2. Materials, finishing & coating TME Handbook Vol.3 by Charles Wick and Raymond F. Veilleux.
3. Metal Pretreatment for Corrosion Control by N.D. Banik.
4. Protective coatings for Metals by Burns and Bradley.
5. Engineering Coatings by Grainger

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-419	Course Name: Utilization of Metallurgical Wastes
Credit:4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Types of metallurgical waste and their sources, their effects on human and social life. Sources and handling of red mud and recovery of valuables from red mud. Applications of red mud-present and future.Recovery of valuables from aluminium pot linings, vanadium sludge,aluminium plant gases and anode butts.Treatment of anode mud from copper production for recovery of precious metals. Treatment of sulphur bearing gases from copperproduction. Treatment of effluents from lead and zinc production.Recovery of valuables from dross during refining of lead.

Books:

1. Encyclopedia of Chemical Tech. (Vol. 1-25) Edited by JacaquelingKroschivtz, John Wiley and sons.
2. Enclycopedia of Chemical Processing & Design, Volume (1-32),Edited by J. Mcketta and William A. Cunnghain, Marcel DekkarInc, New York.
3. Extraction of Copper by Biswas& Davenport.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-421	Course Name:Corrosion science and Engineering
Credit:4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Corrosion principles Faraday's laws of electrolysis, current efficiency, current density, electrode potentials, EMF series,Galvanic series, Nernst Equations, Polarization, Mixed potential theory, Pourbaix-pH diagrams, Passivity – theory and application.

Forms of corrosion: uniform, galvanic, crevice, pitting, intergranular, stress corrosion cracking, corrosion fatigue, hydrogen embrittlement, dealloying. Corrosion prevention and control by various methods- change of metal composition, design improvement, inhibitors, coatings and electrochemical methods of protection.

Books:

1. Mars G.Fontana; Corrosion Engineering,McGraw Hill,3rd Edi. 1987.
2. Corrosion, Vol. 13, Metal Handbook, 9th Edi. Ohio, 1987.
3. S.K.Coubural, Corrosion Source book, Ed.NACE and ASM Metals Prk, Ohio,1987.
4. C.R.Pludek, Design and corrosion contrl, Macmillan, London, 1977.
5. H.H.Uhlig, R.W.Revie, corrosion and its control, 3rd Edi. John Wiley, Singapore,1991.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-423	Course Name:NDT & Quality Control
Credit: 4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Introduction: Need for inspection, types of inspection system, Quality of inspection, Reliability of defect detection and benefits of NDT examination.Visual Inspection: Basic principles, physical aids used for visual inspection and applications.Liquid Penetrant Inspection: Physical principles, procedures of testing, penetrant testing materials, penetrant testing methods,applications and limitations.Magnetic Particle Testing: Principle of MPT, Magnetizationtechniques, procedure used for testing a component, equipment used for MPT, Techniques used for ECT, Applications and limitations.Radiography: Basic principles, electromagnetic radiation sources,effect of radiation in film, radiographic imaging, inspection techniques,applications and limitations.Ultrasonic Testing: Basic principles of sound beam, ultrasonic transducers, type of display, inspection methods, identification of defects, immersion testing, applications and limitations.Acoustic Emission Testing (AET): Principles, technique,Instrumentation and applications. Miscellaneous tests.Reliability in NDT, statistical methods for quality control

Books:

1. Introduction to Physical Metallurgy, S.H. Avner, McGraw Hill Co.
2. Testing of Metallic Materials, A.V.K. Suryanarayana, PHI,New Delhi

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-216	Course Name: Introduction to Nano Materials and Technology
Credit: 4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Synthesis routes for nano and ultra-fine grained materials: bottom up and top down approaches, specific routes such as vapor deposition, sol-gel, rapid solidification processing, high energy ball milling, cryo rolling, and equal channel angular extraction; Specific nano materials such as carbon nanotubes, semiconducting nanomaterials, magnetic ferroelectric, multiferroicnanomaterials, nano ceramic, nanomaterials for structural applications, nano biomaterials, and nanocomposites; Characterization techniques from the perspective of nanomaterials; Properties of nanomaterials: mechanical and functional; Mechanical behaviour of nanomaterials, and superplasticity; Thermodynamics and stability of nanomaterials; Specific applications of nanomaterials.

Books:

1. Di Venttra, Massimiliano; Evoy, Stephen; Helflin Jr. , Jmes R.(Eds.),Introduction to Nanoscale Science and technology, 2004,632 p. ,Springer Verlag, ISBN:978-1-4020-7720-3.
2. Ed Regis Nano : The Emerging Science of Nanotechnology (Paperback)
3. NalwaEncyclopaedia of nano science and technology.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-217	Course Name: Materials Science and Technology
Credit: 4	L-T-P: 3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Introduction to Engineering Materials, their classifications and properties.

Structure of Materials: Types of bonding, structure of crystalline solids, Miller indices for planes and directions, determination of crystal structure by x-rays diffraction.

Packing factor and coordination number in solids. Lattice imperfection in crystalline solids.

Metallic Materials: Introduction to binary phase diagrams, solids solution and intermediate phases, iron-iron carbide and Cu-Zn phase diagram. Properties and applications of industrial important alloys. Brasses, bronzes, duralumin, steel and cast iron.

Polymers: classification, polymerization, structure, properties and applications.

Ceramics: Ceramics structures, properties and applications.

Composites: Classification, properties and applications, nano–composites.

Corrosion and environmental degradation of materials.

Physical and Mechanical Properties: Tensile properties, Hardness, Impact strength, Creep and Fatigue properties of materials.

Books:

1. Introduction to Materials Science : V.
2. Materials Science: Callister