Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-201	Course Name: Introduction to Extractive Metallurgy
Credit:4	L-T-P:(3-1-0)
Version:	Approved on:
Pre-requisite course:	

Syllabus:

Definition and classification of metallurgy, minerals and ores. Primary metal production plants in India.

Agglomeration: Pelletizing and sintering.

Pyrometallurgical process : Calcination, roasting , smelting, refining of leach solution, solvent extraction and ion exchange processes.

Hydrometallurgical processes: Principles and types of leaching, refining of leach solution, cementation, solvent extraction and ion exchange processes, metal recovery from aqueous phase

Electrowinning and electrorefining, aqueous and fused salts, electrolysis.

Simplified flow sheets for the production of iron and steel, Al, Cu, Zn and Pb.

Books:

1. Extraction of non-ferrous Metals by H.S. Ray, R. Sridhar and K.P. Abraham.
2. Principles of Extractive metallurgy by T.R. Rosenquist, McGraw Hill.
3. Extractive metallurgy by J.D. Gilchrist, Oxford pergamon.
4. Engineering metallurgy by R.A Higgins (vol. I & II) ELBS.
5. Encyclopedia of Chemical Technology (Vol. 1-25), Edited by Jacqueline l. Kroschwitz, Jhon Wiley & sons.
6. Encyclopedia of Chemical Processing and Design (Vol. 1-32), Edited by Jhon. J. Mcketta& William A. Cunninghasm, Marcel Dekker Inc. New York.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-203	Course Name: Introduction of Physical Metallurgy
Credit:4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course: Nil	

Syllabus

Solidification.

Principles of alloy formation: Primary and intermediate phases and their formation, solid solution, Hume-Rothery rules, electron compounds, normal valency compounds, Interstitial compounds.

Phase Diagrams: Concepts of alloy system and explanation of terms like system, component, phase, microconstituent and degree of freedom, structural constituents of an alloy, phase rule and phase equilibria, equilibrium diagrams and their classification based on solubility of components in liquid and solid states, cooling curves, morphology and distribution of phase, effect of non-equilibrium cooling on morphology. Eutectic, peritectic, monotectic, eutectoid and peritectoid reactions, binary equilibrium diagrams involving isomorphs systems and various reactions, common binary systems.

Fe-C System: Allotropic changes, construction of Fe-Fe_3C phase diagrams, phases, critical temperatures and invariant reactions.

Books:

1. Introduction to Physical Metallurgy, Sidney H. Avner, McGraw Hill Book Co.
2. Engineering Physical Metallurgy- Yu. Lakhtin, Mir Publishers Moscow, CBS Publishers & Distributors, Indore.
3. Physical Metallurgy- Peter Hansen, Cambridge University Press.
4. Engineering Metallurgy- Applied Physical Metallurgy by R. A. Higginss, Vol.I.
5. Physical Metallurgy Principles, Robert E. Reed-Hill, Affiliated East- West Press Pvt. Ltd., New Dehli.
6. Modern Physical metallurgy, Smallman, R. E., Butterwarths, London.
7. Physical Metallurgy for Engineers, D.S.Clark and W.R.Varney, Affiliated East- West press, New Dehli.
8. Physical Metallurgy, Gulyaev A., Vol. I & II, Mir Publishers Moscow.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-205	Course Name: Thermodynamics of Materials
Credit:4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Thermodynamic system, the state of a system and its transformations.Isothermal and adiabatic expansion of a perfect gas. Forms of energy.First law of thermodynamics, change in internal energy. Hess's law,Kirchhoff's law. Carnot cycle. Second law of thermodynamics.Thermodynamic absolute temperature scale. Reversible and irreversible processes. Criterion for equilibrium.Variation in entropy with temperature, entropy change associated with the phase change,Helmholtz and Gibbs free energy. Gibbs Helmoltz equation. ClausiusClapeyron equation. Maxwell equations. Third law of thermodynamics.Fugacity, activity, equilibrium constant, temperature dependence of equilibrium constant.Thermodynamics of electrochemical cells.Partial molar properties, chemical potential. Gibbs – Duhemequation.Ideal solution, Raoult's law. Henry's law. Sievert's law. Activity coefficient, non-ideal solutions, excess thermodynamic functions.Regular solution. Principles of activity determination methods.

Free energy-temperature diagrams (Ellingham diagrams) for the formation of oxides, sulphides, and chlorides and their applications..Order of reaction and molecularity. Arrhenius Equation. Theories of reaction kinetics. Collision theory, and theory of absolute reaction rate.

Books:

1. Physical Chemistry of Metals by Darken and Gurry
2. Principles of Extractive Metallurgy by Rosenquvist.
3. Introduction to Metallurgical Thermodynamics by Gaskell
4. Chemical and Metallurgical Thermodynamics, by M.L.Kapoor, Vol.I
5. Problems in Metallurgical Thermodynamics and Kinetics by G.S.Upadhyay and R.K.Dube

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-207	Course Name:Introduction to Engineering Materials
Credit: 4	L-T-P:3-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus:

Engineering Materials: Introduction,Classification of engineering materials, salient features of each class of engineering materials.
Properties of Engineering Materials: Physical,chemical and mechanical properties. Factor controlling properties of engineering materials.
Applications of metals and alloys, polymers, ceramics and composites.
Materials with Specific Properties : Electrical conductors, Electrical resisters, Magnetic materials, Structural materials, Refractory materials.

Books:

1.Introduction to Physical Metallurgy, Sidney H. Avener, Mc Graw Hill Book Co.
2. Engineering Physical Metallurgy, Y. Lakhtin, Mir Pub., Moscow, CBS Publisher
3. Engineering Materials – Properties and applications of Metal and Alloys, C. P. Sharma, PHI, New Delhi
4. Engineering Materials, A. K. Bhargava, PHI Learning Pvt. Ltd., New Delhi
5. Introduction to Materials Science, V. Raghvan, PHI Learning Pvt. Ltd.

Template for Course Details

UG	Department: Metallurgical and Materials Engineering
Course Code:MTT-209	Course Name: Fuels, Furnaces & Refractories
Credit: 4	L-T-P: 3-1- 0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Fuels: Definition, their importance in human life (historical background). Comparative study of solid, liquid and gaseous fuels,constitution, classification and grading of coal.Metallurgical coke and carbonization, Testing of fuels.
Furnaces: Evolution of heat and flame temperature, Available heat,Combustion of fuels and problems based on air supplied, excess air and products of combustion. Natural, forced, induced and balanced draft. Chimney Height. Heat losses in furnaces and Minimization.Waste Heat Recovery. Various types of Heating Elements and Electric
Furnaces viz. Resistance, Arc and Induction furnaces.Refractories: Acid, Basic and Neutral refractories, General Properties and Testing, Methods for production of fireclay, silica, Magnesite,Chromemagnesite, dolomite and insulating bricks, their compositions,properties and Applications. Selection of refractories for Metallurgical
Applications, Special refractories such as zirconia and silicon carbide.

Books:

1. Elements of fuels, Furnaces & Refractories by O.P.Gupta.
2. Fuels, Furnaces & Refractories by J.D. Gilchrist.
3. Refractories – M.L.Misra

Template for Course Details

UG	**Department: Metallurgical and Materials Engineering**
Course Code:MTP-211	**Course Name:Fuel and Furnace**
Credit:2	**L-T-P: 0-0-3**
Version:	**Approved on:**
Pre-requisite course:	

Syllabus

1. Determinations of viscosity, fire point, flash point of liquid fuel
2. Calorimetric value of fuel
3. Determination of moisture content in solid fuel
4. Determination of sulphur content in coal
5. DSC study of solid fuel
6. Study of various heating elements including measure of resistance
7. Study of variation of resistance w.r.t temperature of Kanthal/Nichrom
8. Study of various parts furnaces (Induction, Raising Hearth, Muffle)
9. Calibration of thermocouple

Template for Course Details

UG	**Department: Metallurgical and Materials Engineering**
Course Code:MTP-213	**Course Name:Metallurgical and Instrumental Analysis**
Credit:2	**L-T-P: 0-0-3**
Version:	**Approved on:**
Pre-requisite course:	

Syllabus

1. To estimate total iron in iron ore
2. To estimate total silicon in iron and steel
3. To estimate Phosphrous in plain carbon steels and cast iron
4. Estimation of carbon and sulphur simultaneously by carbon-sulphurdeterminator(LECO-USA)
5. Estimation of chromium in alloy steels and alloy cast irons
6. To estimate Manganese in iron and steel
7. Estimation of Nickel in alloy steels and alloy cast irons
8. Estimation of copper inn brass
9. Estimation of lime in limestone
10. Estimation of Tin and Lead in Solders

Template for Course Details

UG	**Department: Metallurgical and Materials Engineering**
Course Code:MTP-215	**Course Name:Metallography**
Credit:2	**L-T-P: 0-0-3**
Version:	**Approved on:**
Pre-requisite course:	
Syllabus 1. Optical microscope 2. Microstructural observation of various important steels 3. Microstructural observation of cast irons 4. Microstructural observation of non-ferrous alloys 5. Metallographic specimen preparation 6. Effect of etchant on the microstructure 7. Quantitative metallography: volume fraction measurement 8. Stereographic projection: Fundamental Principles	