

GOVERNMENT CO-ED POLYTECHNIC JAGDALPUR**Department of Metallurgical Engineering****LESSON PLAN**

Course – Principle of Extractive Metallurgy	Session: July - Dec 2025
Course Instructor – Gaurav Verma	Semester – 3RD

TOPIC	NO. OF PERIODS (HOURS)
UNIT -1 Overview of Extractive Metallurgy	10
Extractive Metallurgy- Concept, Importance and Applications	02
Availability of raw materials in India and Occurrence of metals in nature	02
Unit processes and unit operations of metal extraction	02
Comparison between Pyrometallurgy, Hydrometallurgy and Electrometallurgy	02
Advantages and Limitations of Different Extraction process	02
UNIT-2 Pyrometallurgy	08
Drying and Calcination	01
Roasting, its types and Roasting technique	01
Smelting principle Carbon, Carbon monoxide and Hydrogen Reduction Matte Smelting Converting	03
Importance and limitations of Ellingham diagram	02
Metallo-thermic reduction and halide metallurgy	01
UNIT-3 Hydrometallurgy	10
Principles, factors and application of hydrometallurgy	02
Leaching- Preparation of ore for Leaching Principle of Leaching and types of leach	02
Pressure leaching Bacterial and Microbial leaching	02
Recovery of metal from leach liquor	01
Contact reduction and Gaseous reduction of metals in aqueous solutions	01
Ion Exchange and Solvent Extraction	02
UNIT-4 Electrometallurgy	10
Principle of Electro Deposition-Laws of Electrolysis, Electrolysis of Aqueous and fused salt system	02
Current Efficiency and Energy Efficiency of Electrolysis process, Nernst Equation	02
Relation between cell EMF and free energy and simple numericals	01
Principles of Electro winning and Electro refining	02
Electro winning of Metals from Aqueous and Fused Salt System	02
Electro refining of Metals	01
UNIT-5 Purification of Crude Metals	12
Basic approaches of Refining, Liquation, Vacuum Distillation	02
Iodide and Carbonyl Process ,Fire Refining, Electrolytic Refining	04
Zone Refining, Vacuum Arc Remelting	03
Electro Slag Refining ,Electron Beam Refining	03

No. of Periods (Hours):
No. of Periods (Hours) actually taken:

Head of Department
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Govt. Co-Ed Polytechnic Jagdalpur

GOVERNMENT CO-ED POLYTECHNIC JAGDALPUR	
Department of metallurgical engineering	
Lesson plan	
Course-Material science	Session-July-Dec 2025
Course instructor-Abhinandan kumar	Semester-3
TOPIC	NO.OF PERIODS (HOURS)
UNIT-1 Structure of metals	14
Types of bond(Ionic, Covalent, Vanderwaal & Metallic bond)	2
Crystalline and Amorphous solid	2
Unit cell,Bravais lattice	2
Crystal structure of metal	2
Co-ordination number and atom per unit cell of BCC,FCC,HCP	2
Atomic packing factor of BCC,FCC,HCP	2
Miller indices for planes and directions	2
UNIT-2 Structure of alloy	14
Concept of alloy and different alloying elements	4
Substitutional and Interstitial solid solution	2
Hume Rothery rule	2
Polycrystalline material-definition and properties	3
Methods of grain size determination	3
UNIT-3 Phase diagram	14
Gibbs phase rule & Degrees of freedom	2
Unary phase diagram	1
Isomorphous system,	2
Eutectic, Peritectic , Monotectic, Eutectoid, Peritectoid	2
Tie Line and Lever rule	2
Equilibrium& Non-equilibrium cooling	3
Application of Phase diagram	2
UNIT-4 Iron-Cementite Phase diagram	12
Allotropic form of iron, Cooling and heating curve of Iron	2
Different phases of iron cementite diagram	3
Important reactions of iron- cementite phase diagram	2
Application of Lever rule in iron cementite phase diagram	3
Use and limitation of Iron- Cementite Phase diagram	2
UNIT-5 Metallography	08
Preparation of sample for microscopic examination	3
Principle, operation and applications of metallurgical microscope	3
Sulphur printing & Phosphorus printing	2

GOVERNMENT CO-ED POLYTECHNIC JAGDALPUR	
Department of Metallurgical Engineering	
LESSON PLAN	
Course – Fuel, Furnace & Refractory	Session: JUNE-DEC 2025
Course Instructor – Abhinandan kumar	Semester - 3

TOPIC	NO. OF PERIODS (HOURS)
UNIT -1 Solid Fuels	12
Types of fuel and example of each type (like solid, liquid, gas) Sources of different types of fuels. Comparison of solid, liquid and gaseous fuel	02
Carbonization, Type of carbonization.	02
Manufacturing of coke by Beehive oven and By-product method.	02
Properties of Metallurgical coke	02
Pulverized fuel-Types, properties and advantages.	02
Proximate analysis of coal.	01
Ultimate analysis of coal.	01
UNIT-2 Liquid and Gaseous fuels	12
Origin & Refining of Petroleum	02
Fractional distillation of crude oil	02
Advantages of liquid fuels over solid fuel.	01
Composition, Manufacturing processes, Properties and application of fuels.	02
Water gas, Carbureted water gas, Blast Furnace gas, Coke gas, Natural gas.	02
Advantages of gaseous fuels over solid and liquid fuels.	01
Calculation of air required for combustion.	01
Air required in volume and by weight.	01
UNIT-3 Furnace	12
Classification of furnaces based on uses, process, and fuel.	02
Blast furnace	02
open hearth and LD converter	02
Melting furnaces like Cupola, Rotary furnaces, Crucible furnaces, Electric furnaces.	02
Heat treatment furnaces like muffle and salt bath furnace.	01
Atmospheric control in various furnaces.	01
Waste heat recovery: working principle and types Recuperators and Regenerators:	02
UNIT-4 Refractories	12
Introduction and properties of refractory material.	02
Classification of refractories-Acid, Basic and Neutral.	01
Acid refractories : Raw material Manufacturing processes , properties and uses, Fire Clay and silica refractory.	03
Basic refractories: Raw material manufacture, properties and uses of Magnesite,	03

Dolomite and Chromite refractories.	
Neutral refractories: Raw materials manufacturing processes, properties and uses of Graphite, Carbide, Chrome-magnesite, Silicon Carbide.	03
UNIT-5 Testing & Selection of Refractories.	12
Importance of testing, testing criteria.	01
Testing Methods – visual inspection, Pyro metric cone equivalent (PCE) test.	02
RUL test, thermal conductivity test, Spalling Resistance.	03
Strength and permeability test.	02
Refractory selection for coke oven, iron Blast furnace.	03
Refractory selection for Copper convertor, soaking Reheating furnaces, heat treatment and Electric arc.	01

No. of Periods (Hours): 60
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GOVERNMENT CO-ED POLYTECHNIC JAGDALPUR**Department of Metallurgical Engineering****LESSON PLAN**

Course - Mineral Processing	Session: Nov-Dec 2025
Course Instructor – Pushpendra Alsare	Semester - 3

TOPIC	NO. OF PERIODS (HOURS)
UNIT -1 Introduction of Minerals and Mineral Processing	10
Introduction of minerals	01
Characteristics of mineral	01
Physical properties of mineral	01
Mineral, rock and ore	01
Types of ore	01
Important mineral and ore deposits in India	01
Introduction to mineral processing	01
Advantages of mineral processing	01
Principle operation in mineral processing	01
Comminution, sizing, concentration, dewatering and agglomeration	01
UNIT-2 Comminution	12
Concept of comminution and degree of liberation	01
Crushing	01
Laws of reduction: Rittinger's law, Kick's law and Bond's law	01
Types of crusher	01
Jaw crusher	01
Gyratory crusher	01
Crushing rolls	01
Grinding	01
Types of grinding mills	01
Rolling mill: Ball and Rod mill	01
Hammer mill	01
Attrition and tumbling mill	01
UNIT-3 Sizing	12
Introduction to sizing operation	
Concept of Sieving process	01
Concept of mesh	01
Screening process	01
Criteria for selection of sieving/screening process	01
Types of screening	01
Vibrating and non-vibrating screens	01
Factors affecting screening performance	01
Classification process	01
Types of classifiers	01
Hydraulic classifier	01
Rake classifier	01

UNIT-4 Concentration	12
Introduction to concentration process	01
Sorting	01
Gravity concentration methods	01
Jigging	01
Tabling	01
Flowing film concentration	01
Heavy media separation	01
Froth flotation process	01
Operation of froth flotation process	01
Types of reagents	01
Magnetic and electrostatic separation process	01
Dewatering and drying	01
UNIT-5 Agglomeration	08
Introduction to agglomeration process	01
Sintering process	01
Operation of sintering process	01
Pelletising process	01
Operation of pelletising process	01
Briquetting process	01
Nodulizing process	01
Vaccum extrusion process	01

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GOVERNMENT CO-ED POLYTECHNIC JAGDALPUR	
Department of Metallurgical Engineering	
LESSON PLAN	
Course - Metallurgical Thermodynamics and Kinetics	Session: July - Dec 2025
Course Instructor – Beniram sahu	Semester - 3

TOPIC	NO. OF PERIODS (HOURS)
UNIT -1 Introduction and First Law of Thermodynamics	14
Basic terms related to thermodynamics	02
Internal energy	01
First law of thermodynamics	01
Statement and significance of first law	01
Heat capacity	02
Enthalpy	01
Enthalpy change for a reaction	01
Hess's law	01
Kirchhoff's law	01
Numericals	03
UNIT-2 Second and Third Law of Thermodynamics	10
Second law of thermodynamics	01
Entropy	01
Entropy change for a reaction	01
Combined expression of first and second law	01
Free energy	01
Helmholtz and Gibb's free energy	01
Gibb's Helmholtz equation	01
Third law of thermodynamics	01
Numericals	02
UNIT-3 Chemical Equilibrium	10
Law of mass action	01
Fugacity	01
Activity	01
Equilibrium Constant	01
Relation between free energy and equilibrium Constant	01
Ellingham Diagram	01
Ellingham diagram for oxides	01
Important features of Ellingham diagram	01
Characteristics of different curves of Ellingham diagram	01
Use of Ellingham diagram	01

UNIT-4 Thermodynamics of Solutions and Reaction Kinetics	12
Introduction to solution	01
Ideal and non-ideal solution	01
Henry's law	01
Roult's law	01
Sievert's law	01
Numericals related to solution	01
Introduction to Reaction Kinetics	01
Rate of reaction	01
First and second order reaction	01
Factors affecting rate of reaction	01
Arrhenius equation	01
Numericals related to reaction kinetics	01
UNIT-5 Heat and Mass Transfer	14
Introduction to heat transfer	01
Modes of heat transfer	01
Conduction	01
Steady state and transient conduction	01
Convection	01
Free and forced convection	01
Radiation	01
Black and gray body radiation	01
Reflection, absorption and transmission of radiation	01
Introduction to mass transfer	01
Modes of mass transfer	01
Diffusion mass transfer	01
Fick's first and second law	01
Numericals	01

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