

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI

DIPLOMA PROGRAMME IN METALLURGICAL ENGINEERING

Semester – III

COURSE OF STUDY AND SCHEME OF EXAMINATION (Revised Dated 26-6-06)

S. No	Board of Study	Course Code	Course	Periods/Week (in hours)			Scheme of Examination					Credit L+(T+P)/2	
				L	T	P	Theory			Practical			Total Marks
							ESE	CT	TA	ESE	TA		
1.	Metallurgical Engineering	238311 (38)	Material Science	4	1	-	100	20	20	-	-	140	5
2.	Metallurgical Engineering	238312 (38)	Iron Production	4	1	-	100	20	20	-	-	140	5
3.	Mechanical Engineering	238313 (37)	General Mechanical Engineering	3	1	-	100	20	20	-	-	140	4
4.	Metallurgical Engineering	238314 (38)	Principles of Extractive Metallurgy	3	1	-	100	20	20	-	-	140	4
5.	Metallurgical Engineering	238315 (38)	Thermodynamics	3	1	-	100	20	20	-	-	140	4
6.	Metallurgical Engineering	238321 (38)	Material Science Lab	-	-	4	-	-	-	50	20	70	2
7.	Metallurgical Engineering	238322 (38)	Iron Production Lab	-	-	4	-	-	-	50	20	70	2
8.	Mechanical Engineering	238323 (37)	General Mechanical Engineering Lab	-	-	2	-	-	-	50	20	70	1
10.	Mechanical Engineering	238324 (37)	Workshop Practice	-	-	4	-	-	-	70	20	90	2
TOTAL				17	5	14	500	100	100	220	80	1000	29

L : Lecture hours : T : Tutorial hours, P : Practical hours

ESE – End of Semester Exam.; CT – Class Test; TA- Teacher’s Assessment

Note: Industrial training (for Phase-I) of 2 week will be organised after third semester and evaluation will be done in 4th semester.

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI**

- A) SEMESTER : III
 B) SUBJECT TITLE : MATERIAL SCIENCE
 C) CODE : 238311 (38)
 D) BRANCH/DISCIPLINE : METALLURGICAL ENGINEERING
 E) RATIONALE :

This subject is taught to the student to gain knowledge of engineering materials, their properties and uses. They can learn handling of Metallurgical (Optical) Microscope to know the structure and defects in the structure of metals. This knowledge is very essential to evaluate and distinguish the properties of different material when an Engineer uses these materials. This is perquisite course to understand physical metallurgy and engineering materials and testing, in the final year.

F) TEACHING AND EXAMINATION SCHEME:

Course Code	Teaching Scheme (Hrs./week)				Scheme of Examination						Credit L+(T+P)/2 2
	L	T	P	Total Hours	Theory			Practical		Total Marks	
					ESE	CT	TTA	ESE	PTA		
238311 (38)	4	1	-	5	100	20	20	-	-	140	5
238321 (38)	-	-	4	4	-	-	-	50	20	70	2

G) DISTRIBUTION OF MARKS AND HOURS:

Chapter No.	Chapter Name	Hours	Marks
1	Structure of Metals	12	20
2	Equilibrium Diagram	13	15
3	Iron – Iron Carbide Equilibrium Diagram	13	15
4	Heat Treatment	10	15
5	Magnetic Material and Properties	06	05
6	Electrical Properties and Materials	06	07
7	Thermal Properties and Materials	07	06
8	Metallography	13	17
	Total	80	100

H) DETAILED COURSE CONTENTS:

Chapter- 1: Structure of Metals:

- ?? Crystalline and Amorphous substance,
- ?? Space lattice, Packing of spheres, Unit Cell-Simple cubic, Body Center cubic (BCC), Face Centred cubic (FCC), Hexagonal Closed Packed (HCP) and Diamond cubic, their coordination Number,
- ?? Bravies Lattice, Miller Indices for direction and plane,
- ?? Packing efficiency, of B.C.C. and F.C.C. crystal,
- ?? Atomic bonding – Ionic, Covalent Metallic and Vander wall bond.

Chapter – 2: Equilibrium Diagram :

- ?? Solid Solution – Home Rotheri rule substitution and interstitial solid solution, their examples,
- ?? Binary phase diagrams : Gibbs phase rules, Lever's rule,
- ?? Complete solid solubility Isomorphism System, Partial solid solubility-Eutectic system. Solid state transformation Eutectoid and peritectoid system,
- ?? Coring, Segregation and Dendrite solidification,
- ?? Solidification in metal and sand Moulds,
- ?? Intermetallic compound and intermediate phases, Order – Disorder transformation.

Chapter – 3: Iron – Iron Carbide Equilibrium Diagram :

- ?? Iron – Iron Carbide Equilibrium Diagram,
- ?? Critical temperatures,
- ?? Allotropic forms of Iron, Plain carbon steel, Cast Iron,
- ?? Phase diagram of Cu-Zn (Brass) and Cu-Sn (Bronze) binary system, Al-Si System.

Chapter – 4: Heat Treatment :

- ?? Importance & application of heat treatment,
- ?? Transformation of phases on heat treatment,
- ?? Annealing – Type of Annealing,
- ?? Normalizing,
- ?? Hardening,
- ?? Tempering.

Chapter – 5: Magnetic Materials and Properties :

- ?? Introduction, Basic concept,
- ?? Diamagnetism and Para magnetism,
- ?? Ferro magnetism, anti ferromagnetism and ferrimagnetisms,
- ?? Influences of temperature on magnetic behaviour,
- ?? Domains and hystresis,
- ?? Soft magnetic material and hard magnetic materials,

- ?? Magnetic storage and superconductivity,
- ?? Atomic magnetism, Magnetic Domains, Diamagnetism, Ferrimagnetisms, Paramagnetic, Magnetic Hysteresis,
- ?? Soft Magnetic Materials, Permanent Magnetic Mat. Magneto Strict ion.

Chapter – 6: Electrical Properties And Materials :

- ?? Electrical conductivity – Basic theory for conduction,
- ?? Conductors - Various type and Comparison,
- ?? Insulators - Various type and comparison,
- ?? Resistors - Various type and comparison.
- ?? Semiconductors-types & application.

Chapter – 7: Thermal Properties and Materials :

- ?? Introduction,
- ?? Heat capacity,
- ?? Thermal expansion,
- ?? Thermal stresses,
- ?? Thermal conductivity,
- ?? Thermal Insulating materials,
- ?? Thermal Shock resistance.

Chapter – 8: Metallography :

(a) Macrostructure:

- ?? Preparation of specimen for macro structure examination,
- ?? Contact Printing, S-Print, Oxide Print, P.Print,
- ?? Examination of fracture,
- ?? Porosity examination,
- ?? Segregation, Pipe, Dendritic structure examination.

(b) Microscopic Examination :

- ?? Preparation of specimen for microstructure Examination,
- ?? Mounting of specimen,
- ?? Polishing Technique,
- ?? Etching Technique and Etching Reagent,
- ?? Study of optical Microscope and its Principles.

D) INSTRUCTIONAL STRATEGIES:

?? Lecture Method:

- Teaching through chalk board, O.H.P, LCD Projector.
- Interaction with students through seminar.
- As far as possible concepts are to be visualized by extensive use of charts & models.

?? Industrial Visits:

- Bhilai Steel Plant, Bhilai.
- Bharat Aluminum Company Limited Korba.
- Industrial Estate, Bhilai.

?? Expert Lecturer:

- Expert lecturer are to be arranged on above subject through guest faculty.

?? Demonstration:

- of various space lattices using ball models.

J) LEARNING RESOURCES:

(a) Reference Books

Sl. No.	Title	Author, Publisher, Edition & Year
1	Elements of Physical Metallurgy	Albert G. Guy and John J. Hren., Oxford Book Co.
2	Material science	V. Raghvan, Prentice Hall India
3	Principles of Metallography	Kehl,
4	Engg. Metallurgy – Volume -I	Higgins, The English Universities Press Ltd. London
5	Introduction to Physical Metallurgy	S.H. Avner, Tata Mc Graw Hill
6	Engineering Material science	O.P. Khanna, Dhanpat Rai & Sons.
7	Engineering Physical Metallurgy	Lakhtin, Mir Publication, Moscow

(b) Others:

- ?? VCD's
- ?? Learning Packages through CD
- ?? Lab Manuals
- ?? Chart.

SUBJECT TITLE: MATERIAL SCIENCE LAB

PRACTICAL CODE: 238321 (38)

Total Hours: 64

LIST OF PRACTICALS / TUTORIALS:

1. Preparation of specimen for investigation of Microstructure Polishing.
2. Sulphur Printing.
3. Phosphorous Printing.
4. Oxide Print
5. Preparation of specimen and etching technique.
6. Study of optical Microscope & Metallurgical Microscope.
7. Micro structure examination and, Identification of Phases in Plain carbon steel, Hyper eutectoid steel.
8. Eutectic Steel.
9. Hypo eutectoid steel.
10. Study of Micro structure of (a) Gray (b) White (c) Malleable (d) SGCI.
11. Study of Microstructure of Brass and Cu-Sn.

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI**

- A) SEMESTER : III
 B) SUBJECT TITLE : IRON PRODUCTION
 C) CODE : 238312 (38)
 D) BRANCH/DISCIPLINE : METALLURGICAL ENGINEERING
 E) RATIONALE:

This subject is taught to the students to gain knowledge of Pig iron production and alternative iron making process.

F) TEACHING AND EXAMINATION SCHEME:

Course Code	Teaching Scheme (Hrs./week)				Scheme of Examination						Credit $L+\frac{(T+P)}{2}$
	L	T	P	Total Hours	Theory			Practical		Total Marks	
					ESE	CT	TTA	ESE	PTA		
238312 (38)	4	1	-	5	100	20	20	-	-	140	5
238322 (38)	-	-	4	4	-	-	-	50	20	70	2

G) DISTRIBUTION OF MARKS AND HOURS:

Chapter No.	Chapter Name	Hours	Marks
1	Production of Pig Iron	24	30
2	Agglomeration	08	10
3	Blast Furnace	20	25
4	Equipments & Modernization in Blast furnace	08	10
5	Alternative Iron Making Processes	04	04
6	Raw Materials	03	04
7	Thermodynamics & Kinetics of Sponge Iron	03	05
8	Coal & Gas Based Direct Reduced Iron (DRI)	06	08
9	Impact of DRI on Environment	04	04
	Total	80	100

H) DETAILED COURSE CONTENTS:

Chapter - 1: Production of Pig Iron:

- ~~/~~ Raw materials, its quality and characteristics,
- ~~/~~ Iron ore , Fluxes, Fuels, Sinters,
- ~~/~~ Preliminary treatment of Iron ore,
- ~~/~~ Improvement in the productivity, Blast Furnace cost economic consideration.

Chapter – 2 Agglomeration:

- ~~/~~ Importance of agglomeration, Briquetting, Nodulising, Sintering,
- ~~/~~ Importance of sinter, sintering process,
- ~~/~~ Mechanism of sintering,
- ~~/~~ Factors affecting sinter quality,
- ~~/~~ Sintering M/C, use of sinter,
- ~~/~~ Palletisation, production processes, mechanism of production,
- ~~/~~ Importance of pallets, & its uses.

Chapter – 3 Blast Furnace:

- ~~/~~ Layout of Blast Furnace plant,
- ~~/~~ Blast Furnace contours, design criteria,
- ~~/~~ Description of modern blast furnace, referactories used,
- ~~/~~ Charging arrangement, charge distribution. blast furnace stove,
- ~~/~~ Cleaning of blast furnace,
- ~~/~~ Gases dust catchers, gas scrubber ,electro static precipitator.
- ~~/~~ Reaction in the hearth tuyers bosh, fusion zone, Reaction above fusion zone.
- ~~/~~ Thermodynamics of the blast furnace process,
- ~~/~~ Irregularities in the blast furnace operation, its causes and remedies.

Chapter – 4 Equipments & Modernization in Blast Furnace:

- ~~/~~ Recent trends in Blast furnace operations like, coat dust injection, blast humidification, Draft,
- ~~/~~ Modification in charging system.
- ~~/~~ Uses of computers in blast furnace.
- ~~/~~ Equipments used in blast furnace & blast furnace maintenance.

Chapter - 5 Alternative Iron Making Processes:

- ~~/~~ Need of alternative Iron making processes,
- ~~/~~ Sponge Iron-Introduction,Uses,
- ~~/~~ Different between pig iron and sponge iron. or (Direct Reduced Iron),
- ~~/~~ Industries in C.G & India producing sponge iron.

Chapter – 6 Raw Materials:

- ✍ Raw materials used for production of Sponge Iron,
- ✍ Characterization.

Chapter - 7 Thermodynamics & Kinetics of Sponge Iron :

- ✍ Thermodynamics & Kinetics of Iron oxide reduction,
- ✍ Mechanism of reduction in coal based process,
- ✍ Mechanism of reduction in Gas based process.

Chapter – 8 Coal & Gas Based DRI:

- ✍ Principle & operation of coal based DRI process using Rotary Kilns, Viz SL/RN, TDR etc.,
- ✍ Principle & operation of Gas based DRI: Viz – HYL, MIDREX etc.,
- ✍ Smelting reduction technology for hot metal production Viz, COREX, ROMELT and HISMELT etc.,
- ✍ Use of DRI & HBI in Iron & Steel making.

Chapter – 9 Impact of DRI on Environment:

- ✍ Quality control parameters used in Sponge Iron process,
- ✍ Energy consumption
- ✍ Environmental impact of various alternative Iron making techniques.

I) INSTRUCTIONAL STRATEGIES:

✍ Lecture Method using

- Models, charts, transparencies & VCD package
- Process flow charts.

✍ Industrial Visit

- Bhilai Steel Plant, Bhilai.
- Bharat Aluminum Company Limited Korba
- Industrial Estate, Bhilai

✍ Expert Lectures

- Seminar in selected topics.
- Teaching by industrial experts from Bhilai steel plant and sponge iron industries.

✍ Demonstration

- Cut section model,
- Operation & maintenance of blast furnace
- using Models, charts & transparencies.

J) LEARNING RESOURCES:

(a) Reference Books:

Sl. No.	Title	Author, Publisher, Edition & Year
1	Elements Of Metallurgy	Swaroop, Rastogi Publishers
2	Iron Making	R.H. Tupkary, Khanna Publishers
3	Iron Making	Biswas
4	Alternative Root of Iron Making	Amit Chatterjee
5	The Iron Blast Furnace	Peacey J.G.,Davenport, W.G.

(b) Others:

- ~~///~~ Charts
- ~~///~~ VCDs
- ~~///~~ Journals

SUBJECT TITLE : IRON PRODUCTION LAB

PRACTICAL CODE: 238322 (38)
Total Hours: 64

LIST OF PRACTICALS / TUTORIALS:

1. Study of Blast Furnace & refractory used.
2. Study of Blast Furnace stove.
3. Study of Blast Furnace dust catcher.
4. Study of Electro Static Precipitator.
5. Study of Sintering Machine.
6. Study of Magnetic separator.
7. Blast furnace calculations (Charge calculation based on 1 ton of Pig Iron Production).
8. Study of Gas & Coal based Sponge Iron Plants.
9. Observation of Raw materials for Iron & Sponge Iron making processes.

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI**

- A) **SEMESTER** : **III**
 B) **SUBJECT TITLE** : **GENERAL MECHANICAL ENGINEERING**
 C) **CODE** : **238313 (37)**
 D) **BRANCH/DISCIPLINE** : **METALLURGICAL ENGINEERING**
 E) **RATIONALE** :

The purpose of this subject is to introduce concept of General Mechanical Engineering to the students to understand the fundamental principle, concept involved in shaping and deformation processes. This subject covers the theories and practices of mechanical working of metals and industrial application of I.C. engines, Mechanical drives, Material handling equipment, Steam & gas power plants and sheet metal working. The scope of the subject is very wide and as such some processes such as design of simple component, hydrodynamic and hydrostatics have been included to some extent to understand the fundamental principle, concept involved in process.

F) TEACHING AND EXAMINATION SCHEME:

Course Code	Teaching Scheme (Hrs./week)				Scheme of Examination						Credit [L+(T+P)] 2
	L	T	P	Total Hours	Theory			Practical		Total Marks	
					ESE	CT	TTA	ESE	PTA		
238313 (37)	3	1	-	4	100	20	20	-	-	140	4
238323 (37)	-	-	2	2	-	-	-	50	20	70	1

G) DISTRIBUTION OF MARKS AND HOURS:

Chapter No.	Chapter Name	Hours	Marks
1	Mechanical Properties & Simple Stress & Strain	08	10
2	Material Handling	06	10
3	Design of Simple Component	06	10
4	Hydrostatics	06	10
5	Hydrodynamics	06	10
6	Basics of Thermodynamics	06	10
7	Steam & Gas Power Plants	06	10
8	I.C. Engines	06	10
9	Mechanical Drives	06	10
10	Maintenance	06	10
	Total	64	100

H) DETAILED COURSE CONTENTS:

Chapter – 1 Mechanical Properties & Simple Stress & Strain:

- ~~/~~ Definition of different mechanical properties – elasticity plasticity, ductility, toughness, brittleness, , malleability,
- ~~/~~ Formability, weld-ability, hardness,
- ~~/~~ Tensile, compressive , shear stress & strain.

Chapter – 2 Material Handling:

- ~~/~~ Determination of handling equipment requirement,
- ~~/~~ Types of handling equipment,
- ~~/~~ Factor affecting the choice of handling equipment.

Chapter – 3 Design of Simple Component:

- ~~/~~ Cotter joint, knuckle joint, Flange Coupling,
- ~~/~~ Tearing, Crushing and Shearing failures of single row riveted joint.

Chapter – 4 Hydrostatics:

- ~~/~~ Physical properties of a fluid,
- ~~/~~ Pascal's law, center of pressure,
- ~~/~~ Calculation of total force & center of Pressure for rectangular plate.

Chapter – 5 Hydrodynamics:

- ~~/~~ Continuity equation of flow.
- ~~/~~ Bernoulli's equation
- ~~/~~ Venturimeter & its use as pressure measurement device.
- ~~/~~ Flow through pipes,
- ~~/~~ Study of various types of pump.

Chapter – 6 Basics of Thermodynamics:

- ~~/~~ Properties, Processes,
- ~~/~~ Basic laws of thermodynamics,
- ~~/~~ Thermodynamic cycles,
- ~~/~~ Auto, Diesel and Dual cycles.

Chapter – 7 Steam & Gas Power Plants:

- ~~/~~ Boilers,
- ~~/~~ Mounting & accessories,
- ~~/~~ Ranking cycle,
- ~~/~~ Working principle of turbine & compressors,
- ~~/~~ Working principle of Condenser, Pumps etc.

Chapter – 8 I.C. Engines:

- ~~/~~ Working principles of two stroke & four stroke petrol engine,
- ~~/~~ Working principles of two stroke & four stroke Diesel engine,
- ~~/~~ Actual & Theoretical PV Diagrams,
- ~~/~~ Thermal & Mechanical Efficiencies,
- ~~/~~ Indicated, Brake & Frictional Horse Powers (IHP, BHP, FHP) calculations.

Chapter – 9 Mechanical Drives:

- ~~/~~ Rope, chain, belt,
- ~~/~~ Clutch, gearbox, working principle,
- ~~/~~ Related simple problems.

Chapter – 10 Maintenance:

- ~~/~~ Maintenance methods,
- ~~/~~ Types of maintenance,
- ~~/~~ Their importance.

D) INSTRUCTIONAL STRATEGIES:

~~/~~ Lecture Method:

- using chalk board, O.H.P, LCD Projector.
- Interaction with students through seminar.
- As far as possible concepts are to be visualized by extensive use of charts & models

~~/~~ Industrial Visits:

- Bhilai Steel Plant, Bhilai.
- Bharat Aluminum Company Limited, Korba.
- Industrial Estate, Bhilai

~~/~~ Demonstration:

- Demonstration of boilers & power generation system in laboratory.
- Demonstration of mechanical devices and machine components using small desktop models.

J) LEARNING RESOURCES:

(a) Reference Books

Sl. No.	Title	Author, Publisher, Edition & Year
1	Text book of hydraulics	R.S. Khurmi, S. Chand & Co.
2	Text book of thermodynamics	R.S. Khurmi, S. Chand & Co.
3	Text book of design & mechanics of machine	R.S. Khurmi, S. Chand & Co.
4		

(b) Others:

- ~~///~~ Models, charts, Transparencies, Video films etc.
- ~~///~~ Desktop models of boilers, engine, mechanical devices and simple machine components.
- ~~///~~ Charts showing details of different mechanical components.
- ~~///~~ Design data book.
- ~~///~~ Lab manual
- ~~///~~ ISI-Codes.

SUBJECT TITLE : GENERAL MECHANICAL ENGINEERING, LAB

PRACTICAL CODE: 238323 (37)

Total Hours: 32

LIST OF PRACTICALS / TUTORIALS:

- ~~///~~ Study of Locomotive Boiler.
- ~~///~~ Study of Lancashire Boilre.
- ~~///~~ Study of Babcock-Wilcox Boiler.
- ~~///~~ Study of Boiler Mountings & Accessories.
- ~~///~~ Study of Two-Stroke Petrol Engine.
- ~~///~~ Study of Four-Stroke Petrol Engine.
- ~~///~~ Study of Four-Stroke Diesel Engine.
- ~~///~~ Study of different types of material handling equipments.
- ~~///~~ Study of Multi plate clutch.
- ~~///~~ Study of Two Wheeler Gear Box.
- ~~///~~ Study of various Joints & Couplings.

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI**

- A) SEMESTER : III
 B) SUBJECT TITLE : PRINCIPLES OF EXTRACTIVE METALLURGY
 C) CODE : 238314 (38)
 D) BRANCH/DISCIPLINE : METALLURGICAL ENGINEERING
 E) RATIONALE :

This subject is taught to the students to gain knowledge of general principles & methods of extraction & ore dressing

F) TEACHING AND EXAMINATION SCHEME :

Course Code	Teaching Scheme (Hrs./week)				Scheme of Examination						Credit L+ $\frac{(T+P)}{2}$
	L	T	P	Total Hours	Theory			Practical		Total Marks	
					ESE	CT	TTA	ESE	PTA		
238314 (38)	3	1	-	4	100	20	20	-	-	140	4

G) DISTRIBUTION OF MARKS AND HOURS :

Chapter No.	Chapter Name	Hours	Marks
1	General Principles of Extraction of Metals	06	10
2	General Methods of Extraction & Refining of Metal	06	10
3	Principles of Pyrometallurgy	12	15
4	Fundamental Study of Hydro-Metallurgy	12	15
5	Fundamental Study of Electro-Metallurgy	08	10
6	Ore Dressing	20	40
	Total	64	100

H) DETAILED COURSE CONTENTS:

Chapter - 1 General Principles of Extraction of Metals:

- ~~/~~ A process of separation. Classification of process,
- ~~/~~ Characteristics of some unit processes and unit operations,
- ~~/~~ To study Free Energy Diagram of oxide, sulphide, chlorides ore.

Chapter – 2 General Methods of Extraction & Refining of Metal:

- ~~/~~ Some unit process for preliminary treatment of ores,
- ~~/~~ Unit process for metal Extraction,
- ~~/~~ Classification of Metallurgical, Reactors,
- ~~/~~ Extraction of Some Reactive Metal,
- ~~/~~ Refining Process.

Chapter – 3 Principles of Pyrometallurgy:

- ~~/~~ Drying calcinations,
- ~~/~~ Roasting, Smelting,
- ~~/~~ Converting,
- ~~/~~ Fire Refining Fluxes.

Chapter - 4 Fundamental Study of Hydrometallurgy:

- ~~/~~ Hydrometallurgy,
- ~~/~~ Hydrometallurgical Process,
- ~~/~~ Advantage and disadvantage of Hydrometallurgy,
- ~~/~~ Leaching Reagents, Kinetics of Leaching.

Chapter - 5 Fundamental Study of Electrometallurgy:

- ~~/~~ Faraday's law of Electrolysis,
- ~~/~~ Basic arrangement in electrolysis,
- ~~/~~ Electrolytic Media.

Chapter - 6 Ore Dressing:

- ~~/~~ Occurrence of metallic ore in India.
- ~~/~~ Classification of ore,
- ~~/~~ Various ore dressing operation:
- ~~/~~ Ore comminution – (i) Crushing (ii) Grinding,
- ~~/~~ Sizing – Types of screen, Bar screen, Vibrating screen,
- ~~/~~ Classification – Description of various classifiers,
- ~~/~~ Concentration – Panning, Jigging, Tabling, Froth flotation, Differential flotation, Magnetic separation.

I) INSTRUCTIONAL STRATEGIES:

~~/~~ **Lecture Method:**

- Using chalk board, O.H.P, LCD Projector.
- Interaction with students through seminar.
- As far as possible concepts are to be visualized by extensive use of charts & models.

~~/~~ **Industrial Visit:**

- Bhilai Steel Plant, Bhilai.
- Bharat Aluminum Company Limited, Korba.
- Industrial Estate, Bhilai

~~✍~~ **Expert Lecture:** Expert lecturer are to be arranged on above subject.

~~✍~~ **Demonstration:**

J) LEARNING RESOURCES:

(a) Reference Books

Sl. No.	Title	Author, Publisher, Edition & Year
1	Ore dressing by	Gaudin
2	Elements of metallurgy by	Dr. Swaroop
3	Principle of extractive metallurgy by	H.S. Ray & A. Ghosh
4	Extractive metallurgy	H.S.Ray,Shridhar,Abraham

(b) Others:

- ~~✍~~ Models, charts, Transparencies, Video films etc.
- ~~✍~~ Cut section models of different Ore Dressing Process.
- ~~✍~~ Charts on various topics and chapters.

LIST OF PRACTICALS / TUTORIALS:

- ~~✍~~ Mineral dressing flowsheet of some important ore like Cu,Zn,Fe,Pb,Ag.
- ~~✍~~ Flowsheet of metal extracted by Pyrometallurgical route.
- ~~✍~~ Flowsheet of metal extracted by Hydro-Electro metallurgical route.
- ~~✍~~ Construction of Ellingham's Diagram for
 - ~~✍~~ Oxides
 - ~~✍~~ Sulphides
 - ~~✍~~ Chlorides

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI**

- A) SEMESTER : III
 B) SUBJECT TITLE : THERMODYNAMICS
 C) CODE : 238315 (38)
 D) BRANCH/DISCIPLINE : METALLURGICAL ENGINEERING
 E) RATIONALE :

Most of the metallurgical processes are chemical in nature and need thermal transformation. For efficient control of metallurgical processes and their heat balance, knowledge of thermodynamics and kinetics are essential. For achieving this it is important to understand the principle and processes of metallurgical thermodynamics. This subject includes thermochemistry, thermodynamic kinetics, and electrochemistry of metallurgical substances.

F) TEACHING AND EXAMINATION SCHEME:

Course Code	Teaching Scheme (Hrs./week)				Scheme of Examination					Credit [L+(T+P)] 2	
	L	T	P	Total Hours	Theory			Practical			Total Marks
					ESE	CT	TTA	ESE	PTA		
238315 (37)	3	1	-	4	100	20	20	-	-	140	4

G) DISTRIBUTION OF MARKS AND HOURS:

Chapter No.	Chapter Name	Hours	Marks
1	Thermochemistry	06	10
2	Thermodynamics	06	10
3	Chemical Equilibrium	13	20
4	Reaction Kinetics	13	20
5	Thermodynamics & Kinetics of Metallurgical Processes	10	15
6	Liquid Metal Solution	10	15
7	Electrochemistry	06	10
	Total	64	100

H) DETAILED COURSE CONTENTS:

Chapter – 1 Thermochemistry :

~~Exo~~ Exothermic and endothermic reactions,

- ~~/~~ Standard enthalpy change for a reaction,
- ~~/~~ Calculating enthalpies and enthalpy change,
- ~~/~~ First Law of Thermodynamics,
- ~~/~~ Hess Law of constant heat summation,
- ~~/~~ Measurement of enthalpy change of reactions,
- ~~/~~ Effect of temperature on enthalpy changes,
- ~~/~~ Heat capacity, Kirchoff's equation,
- ~~/~~ Material balance Problems related to Kirchoff's & Hess's Law.

Chapter – 2 Thermodynamics :

- ~~/~~ The first Law of thermodynamics,
- ~~/~~ Entropy: the second factor governing energy changes,
- ~~/~~ Free energy: the driving force of a chemical reaction,
- ~~/~~ The Gibb's Helmholtz equation (second law),
- ~~/~~ The effect of temperature & feasibility reactions,
- ~~/~~ Calculating free energy.

Chapter – 3 Chemical Equilibrium:

- ~~/~~ Law of mass action.
- ~~/~~ The effect of concentration on solutions,
- ~~/~~ Factors affecting the position of equilibrium,
- ~~/~~ Relationship between free energy and equilibrium,
- ~~/~~ Variation of vapour pressure with temperature,
- ~~/~~ Standard free energy temperature diagram, Application to metal extraction,
- ~~/~~ Construction of free energy temperature diagram, its uses, advantages & disadvantages,
- ~~/~~ Problems on free energy calculation & Vapour pressure calculation.

Chapter – 4 Reaction Kinetics :

- ~~/~~ Rate of reaction,
- ~~/~~ Effect of concentration on rate of reaction,
- ~~/~~ Surface catalysts, concentration time graph,
- ~~/~~ Kinetics and mechanism,
- ~~/~~ Order reactions.
- ~~/~~ Reversible reactions, Kinetics and temperature,
- ~~/~~ The Arrhenius equation,
- ~~/~~ Determination of activation energy,
- ~~/~~ Effect of Temperature and catalysts on reaction kinetics.

Chapter – 5 Thermodynamics & Kinetics of Metallurgical Processes:

Metallurgical Processes such as-

- ~~/~~ Deoxidation,
- ~~/~~ Desulphurisation,

- ~~/~~ Decarburisation,
- ~~/~~ Dephosphorisation
- ~~/~~ Degassing of steel Melts.

Chapter – 6 Liquid Metal Solution:

- ~~/~~ Solution composition,
- ~~/~~ Thermodynamics of solutions,
- ~~/~~ Partial and integral quantities,
- ~~/~~ The Gibb's duhem equation,
- ~~/~~ Ideal solution and activity,
- ~~/~~ Roul't's Law, Non Ideal and real solutions,
- ~~/~~ Henry's Law and dilute solutions,
- ~~/~~ Activity calculation, Interaction Coefficient problems.

Chapter – 7 Electrochemistry :

- ~~/~~ Electrolytes,
- ~~/~~ Aqueous solutions of electrolytes,
- ~~/~~ The comparison of electrode potentials,
- ~~/~~ Electrochemical series,
- ~~/~~ Diagrammatic representation of Cells,
- ~~/~~ The standard electrode potential,
- ~~/~~ Cell mechanism, Concentration Cell, Cell Thermodynamics,
- ~~/~~ The Nerst equation, Calculation of Decomposition Voltage,
- ~~/~~ Electrolysis Farady's Law of Electrolysis,
- ~~/~~ Current efficiency, Current density.
- ~~/~~ Applications of Electrolysis in Metallurgical problems.

I) INSTRUCTIONAL STRATEGIES:

~~/~~ **LECTURE METHOD:**

- Teaching through chalk board
- O.H.P, LCD Projector.
- Interaction with students through seminar.
- As far as possible concepts are to be visualized by extensive use of charts & models.

~~/~~ **Industrial Visits :**

- Bhilai Steel Plant, Bhilai.
- Bharat Aluminium Company Limited Korba.
- Industrial Estate, Bhiali.

~~///~~ **Expert Lectures:**

- Expert lectures are to be arranged on above subject

~~///~~ **Demonstration:**

J) LEARNING RESOURCES:

(a) Reference Books

Sl. No.	Title	Author, Publisher, Edition & Year
1	Metallurgical Thermodynamics	Tupkary
2	Chemical Thermodynamics	Moor
3	Physical Chemistry of Metals	Darken & Gurry Mcgraw Hill Book Col International Edn.
4	Chemical & Process Thermodynamics Second Addition	Kyle. Printice Hall Of India Ltd.
5	Chemical Kinetics	Shewmen.
6	Metallurgical Thermodynamics	A. Ghosh
7	Metallurgical Thermodynamics	Gashel
8	Chemical Thermodynamics	Kapoor

(b) Others:

- ?? VCD
- ?? Learning Packages through CD
- ?? Lab Manuals
- ?? Chart.

LIST OF PRACTICALS / TUTORIALS:

- ~~///~~ Enthalpy Calculations based on Hess's Law
- ~~///~~ Problems on change of Enthalpy with temperature.
- ~~///~~ Problems on Material Balance.
- ~~///~~ Calculation of Free energy in Metallurgical reaction.
- ~~///~~ Calculation based upon Faraday's Law of Electrolysis.
- ~~///~~ Problem based on solutions.

**CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI**

- A) SEMESTER : III
 B) COURSE TITLE : WORKSHOP PRACTICE
 C) CODE : 238324 (37)
 D) BRANCH/DISCIPLINE : METALLURGICAL ENGINEERING
 E) RATIONALE :

Rapid development in technology & competitive economy has led to the development of new trends & tools in manufacturing industry such as conventional manufacturing with new methods and tools, CNC Machines, Automation, FMS etc. Diploma engineer in professional life has to operate, supervise and maintain production systems available in the industry. In view of this, it is mandatory for him to understand the fundamentals, concepts, principles and advancements in the manufacturing processes while working on the shop floor.

F) TEACHING AND EXAMINATION SCHEME:

Course Code	Teaching Scheme (Hrs./week)				Scheme of Examination						Credit L+ $\frac{(T+P)}{2}$
	L	T	P	Total Hours	Theory			Practical		Total Marks	
					ESE	CT	TTA	ESE	PTA		
238324 (37)	-	-	4		-	-	-	70	20	90	2

LIST OF PRACTICALS / TUTORIALS:

- ?? Industrial visits and report preparation on any two heat treatment processes.
- ?? Preparation of two types of pattern considering all the aspects of pattern making with the help of production drawing.
- ?? Industrial visits and report preparation on any two casting processes.
- ?? Green sand mould preparation and finishing.
- ?? One job comprises of simple turning, step turning and taper turning.
- ?? One job on each internal & external thread cutting (V or Square).
- ?? Practical on Tool grinding
- ?? One job on Black smithy.
- ?? One job on drilling machine comprises of drilling, counter sinking, tapping.
- ?? One job on of welding using gas welding technique.
- ?? One job on each, lap welding and T- joint welding.
- ?? Visit to an industry having CNC machines and Automation facilities and then preparation of report.

Practical Journal is to be prepared on above work.