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)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Board of Study</th>
<th>Course Code</th>
<th>Course</th>
<th>Periods/Week (in hours)</th>
<th>Scheme of Examination</th>
<th>Credit</th>
<th>L : Lecture hours ; T : Tutorial hours, P : Practical hours</th>
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<td>238311 (38)</td>
<td>Material Science</td>
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<td>100 20 20 - -</td>
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<td>Iron Production</td>
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<td>Mechanical Engineering</td>
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<td>General Mechanical Engineering</td>
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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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Teaching Scheme (Hrs./week)</th>
<th>Scheme of Examination</th>
<th>Credit</th>
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G) DISTRIBUTION OF MARKS AND HOURS:

<table>
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<th>Chapter Name</th>
<th>Hours</th>
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<td>1</td>
<td>Structure of Metals</td>
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<td>2</td>
<td>Equilibrium Diagram</td>
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<td>3</td>
<td>Iron – Iron Carbide Equilibrium Diagram</td>
<td>13</td>
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</tr>
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<td>4</td>
<td>Heat Treatment</td>
<td>10</td>
<td>15</td>
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<tr>
<td>5</td>
<td>Magnetic Material and Properties</td>
<td>06</td>
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<td>6</td>
<td>Electrical Properties and Materials</td>
<td>06</td>
<td>07</td>
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<td>Thermal Properties and Materials</td>
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<td>Metallography</td>
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H) DETAILED COURSE CONTENTS:

Chapter- 1: Structure of Metals:
Chapter – 2: Equilibrium Diagram:

- 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,

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 hysteresis,
- Soft magnetic material and hard magnetic materials,
Magnetic storage and superconductivity,
Atomic magnetism, Magnetic Domains, Diamagnetism, Ferrimagnetisms, Paramagnetic, Magnetic Hysteresis,

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.
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 Aluminum Company Limited Korba.
- Industrial Estate, Bhilai.

?? Expert Lecturer:
- Expert lecturers are to be arranged on above subject through guest faculty.

?? Demonstration:
- of various space lattices using ball models.

J) LEARNING RESOURCES:

(a) Reference Books

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title</th>
<th>Author, Publisher, Edition &amp; Year</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Elements of Physical Metallurgy</td>
<td>Albert G. Guy and John J. Hren., Oxford Book Co.</td>
</tr>
<tr>
<td>2</td>
<td>Material science</td>
<td>V. Raghvan, Prentice Hall India</td>
</tr>
<tr>
<td>3</td>
<td>Principles of Metallography</td>
<td>Kehl,</td>
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<tr>
<td>5</td>
<td>Introduction to Physical Metallurgy</td>
<td>S.H. Avner, Tata Mc Graw Hill</td>
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<tr>
<td>7</td>
<td>Engineering Physical Metallurgy</td>
<td>Lakhtin, Mir Publication, Moscow</td>
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</table>

(b) Others:
- VCD’s
- Learning Packages through CD
- Lab Manuals
- Chart.

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LIST OF PRACTICALS / TUTORIALS:

1. Preparation of specimen for investigation of Microstructure Polishing.
2. Sulphur Printing.
4. Oxide Print
5. Preparation of specimen and etching technique.
8. Eutectic 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:

<table>
<thead>
<tr>
<th>Course Code</th>
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G) DISTRIBUTION OF MARKS AND HOURS:

<table>
<thead>
<tr>
<th>Chapter No.</th>
<th>Chapter Name</th>
<th>Hours</th>
<th>Marks</th>
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<tbody>
<tr>
<td>1</td>
<td>Production of Pig Iron</td>
<td>24</td>
<td>30</td>
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<tr>
<td>2</td>
<td>Agglomeration</td>
<td>08</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Blast Furnace</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>Equipments &amp; Modernization in Blast furnace</td>
<td>08</td>
<td>10</td>
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<tr>
<td>5</td>
<td>Alternative Iron Making Processes</td>
<td>04</td>
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<tr>
<td>6</td>
<td>Raw Materials</td>
<td>03</td>
<td>04</td>
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<tr>
<td>7</td>
<td>Thermodynamics &amp; Kinetics of Sponge Iron</td>
<td>03</td>
<td>05</td>
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<td>8</td>
<td>Coal &amp; Gas Based Direct Reduced Iron (DRI)</td>
<td>06</td>
<td>08</td>
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<tr>
<td>9</td>
<td>Impact of DRI on Environment</td>
<td>04</td>
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<td><strong>80</strong></td>
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</table>
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:

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<thead>
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<th>Title</th>
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<tr>
<td>1</td>
<td>Elements Of Metallurgy</td>
<td>Swaroop, Rastogi Publishers</td>
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<tr>
<td>2</td>
<td>Iron Making</td>
<td>R.H. Tupkary, Khanna Publishers</td>
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<td>3</td>
<td>Iron Making</td>
<td>Biswas</td>
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<td>4</td>
<td>Alternative Root of Iron Making</td>
<td>Amit Chatterjee</td>
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<tr>
<td>5</td>
<td>The Iron Blast Furnace</td>
<td>Peacey J.G., Davenport, W.G.</td>
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(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.
5. Study of Sintering Machine.
7. Blast furnace calculations (Charge calculation based on 1 ton of Pig Iron Production).

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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 \[L+(T+P)\] \\
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<tbody>
<tr>
<td>1</td>
<td>Mechanical Properties &amp; Simple Stress &amp; Strain</td>
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<td>Material Handling</td>
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<td>3</td>
<td>Design of Simple Component</td>
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<td>Hydrostatics</td>
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<td>Basics of Thermodynamics</td>
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<td>Steam &amp; Gas Power Plants</td>
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<td>I.C. Engines</td>
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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
- Venturimetre & 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 Diadrams,
- 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.

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 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**

<table>
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</table>

(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 Boiler.
- 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.

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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 :

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Teaching Scheme (Hrs./week)</th>
<th>Scheme of Examination</th>
<th>Credit L+ (T+P)/2</th>
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G) DISTRIBUTION OF MARKS AND HOURS :

<table>
<thead>
<tr>
<th>Chapter No.</th>
<th>Chapter Name</th>
<th>Hours</th>
<th>Marks</th>
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<tbody>
<tr>
<td>1</td>
<td>General Principles of Extraction of Metals</td>
<td>06</td>
<td>10</td>
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<tr>
<td>2</td>
<td>General Methods of Extraction &amp; Refining of Metal</td>
<td>06</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Principles of Pyrometallurgy</td>
<td>12</td>
<td>15</td>
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<tr>
<td>4</td>
<td>Fundamental Study of Hydro-Metallurgy</td>
<td>12</td>
<td>15</td>
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<tr>
<td>5</td>
<td>Fundamental Study of Electro-Metallurgy</td>
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<td>6</td>
<td>Ore Dressing</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title</th>
<th>Author, Publisher, Edition &amp; Year</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Ore dressing by</td>
<td>Gaudin</td>
</tr>
<tr>
<td>2</td>
<td>Elements of metallurgy by</td>
<td>Dr. Swaroop</td>
</tr>
<tr>
<td>3</td>
<td>Principle of extractive metallurgy by</td>
<td>H.S. Ray &amp; A. Ghosh</td>
</tr>
<tr>
<td>4</td>
<td>Extractive metallurgy</td>
<td>H.S.Ray, Shridhar, Abraham</td>
</tr>
</tbody>
</table>

(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

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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:

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<td>2</td>
<td>Thermodynamics</td>
<td>06</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Chemical Equilibrium</td>
<td>13</td>
<td>20</td>
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<td>4</td>
<td>Reaction Kinetics</td>
<td>13</td>
<td>20</td>
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<tr>
<td>5</td>
<td>Thermodynamics &amp; Kinetics of Metallurgical Processes</td>
<td>10</td>
<td>15</td>
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<td>6</td>
<td>Liquid Metal Solution</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Electrochemistry</td>
<td>06</td>
<td>10</td>
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<td></td>
<td><strong>64</strong></td>
<td><strong>100</strong></td>
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</tbody>
</table>

H) DETAILED COURSE CONTENTS:

Chapter – 1 Thermochemistry:

- 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 Arhenious 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,
Roult’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
- 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, Bhilai.
Expert Lectures:
- Expert lectures are to be arranged on above subject

Demonstration:

J) LEARNING RESOURCES:

(a) Reference Books

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<td>Metallurgical Thermodynamics</td>
<td>Tupkary</td>
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<td>2</td>
<td>Chemical Thermodynamics</td>
<td>Moor</td>
</tr>
<tr>
<td>3</td>
<td>Physical Chemistry of Metals</td>
<td>Darken &amp; Gurry</td>
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<td>Mcgraw Hill Book Col International Edn.</td>
</tr>
<tr>
<td>4</td>
<td>Chemical &amp; Process Thermodynamics</td>
<td>Kyle. Printice Hall Of India Ltd.</td>
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<td>Chemical Kinetics</td>
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<td>Metallurgical Thermodynamics</td>
<td>Gashel</td>
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<tr>
<td>8</td>
<td>Chemical Thermodynamics</td>
<td>Kapoor</td>
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</tbody>
</table>

(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.

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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:

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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 Blacksmithy.
- 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.