## Scheme of Teaching & Examination

### B.E. VII Semester Metallurgical Engineering

<table>
<thead>
<tr>
<th>S. No</th>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Periods per Week</th>
<th>Scheme of Exam</th>
<th>Total Marks</th>
<th>Credit</th>
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<td>L</td>
<td>T</td>
<td>P</td>
<td>ESE</td>
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<tr>
<td>1</td>
<td>Metallurgical Engineering</td>
<td>338711(38)</td>
<td>Ferrous Extraction Metallurgy –II</td>
<td>4</td>
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<td>Non Ferrous Extraction Metallurgy</td>
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<td>Electrometallurgy and Corrosion</td>
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<td>Metallurgical Engineering</td>
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<td>Alloys Their Properties and Selection</td>
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<td>Professional Elective – II</td>
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<td>Ferrous Extraction Metallurgy - II Lab</td>
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<td>Alloys and Their Properties and Selection Lab</td>
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<td>Electrometallurgy and Corrosion Lab</td>
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<td>Metallurgical Engineering</td>
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<td>Minor Project</td>
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<td>Management</td>
<td>300725(46)</td>
<td>Innovative and Entrepreneurial Skills</td>
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<td>11</td>
<td>Metallurgical Engineering</td>
<td>338726(38)</td>
<td>**Practical Training Evaluation and Library</td>
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<td><strong>Total</strong></td>
<td>20</td>
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<td>15</td>
<td>620</td>
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</table>

L - Lecture  T - Tutorial  P - Practical  ESE = End Semester Exam  CT - Class Test  TA - Teacher's Assessment

**to be completed after VI sem and before the commencement of VII sem**

### Note:

1. 1/4th of total strength of students subject to minimum of twenty students is required to offer in elective in the college in a particular academic session.

2. Choice of elective code once made for an examination can not be changed in future examinations.
UNIT - 1

UNIT - 2

UNIT - 3

UNIT – 4
Refining of ferrous – melt under oxygen jet. Mechanism of refining and kinetics. Basic oxygen furnace (BOF ) STEEL MAKING, thermal balance in oxygen converter, process control in L. D. converter, treatment of high phosphorous iron in modified L. D. processes, Kaldo and Rotor process.

UNIT – 5

Name of the Text Books
1. Steel Making Technology – Kudrin

Name of Reference Books:
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: VII  
Subject: Non-Ferrous Extraction Metallurgy  
Total Theory Periods: 50  
Total Marks in End Semester Exam: 80  
Minimum number of class test to be conducted: 2

Unit-I

Unit-II:

Unit-III
Extraction of zinc from horizontal and vertical retort processes, imperial smelting process, production of other metals by I S P. Zinc from lead slag. Zinc production in India. Refining of zinc by distillation in refluxing units. Lead oxide from roasted sulphide ores/ concentrates (Dwight Lloyd sintering m/c) Treatment of sinter in lead blast furnace; base bullion production. Refining of lead bullion by Parkes process, dezincing and debismuthing. Modern developments in lead smelting; Production of Lead in India. Tin ores and flowsheet for tin extraction. Pyrometallurgical refining of tin. Recovery of secondary copper. Secondary lead and secondary Zinc and Tin (only flowsheets)

Unit-IV
Beneficiation of Beach sands Vacuum reduction and refining of reactive metals, Halide Metallurgy. Production of pure metals, melting of metal sponge. Transport reactions. Extraction of Titanium from Beach sands. Uranium Thorium and Zirconium extraction in India-general flowsheet for Beryllium.

Unit-V

Name of Text Books:
Unit – I Principles of Electrochemistry
Aqueous electrolytes, ionic conductivity; pH Electrolytic conduction Electrode Potential, Equilibrium decomposition and Redox potentials, cell mechanism and thermodynamics E.M.F. series polarization and over voltage current efficiency and energy efficiency of electrolytic processes calculations based on the above.

Unit – II Electroplating
Principles of Electroplating and factors affecting electro deposition of metals, Preplating operations Electro plating of copper, nickel, chromium, cadmium, zinc, tin and aluminium Principle of alloy position and brass plating Anodizing. Electroless plating and Electroforming A brief idea of air-pollution and control in these processes.

Unit – III Electrowinning and electro refining
Electrowinning of metals from aqueous solutions and fused salt electrolytes Hydrometallurgical technique for the extraction of copper, zinc and manganese fused salt process for aluminium and magnesium extraction Electro refining of copper nickel silver and gold.

Unit – IV Corrosion
Corrosion damage economics oil corrosion electrochemical mechanism of corrosion Forms of corrosion Uniform attack galvanic corrosion crevice corrosion piling corrosion. Intergranular corrosion, erosion corrosion, stress corrosion cracking, hydrogen cracking, corrosion fatigue, cavitation corrosion, fretting corrosion and dezincification. Passivity – Definition characteristics of passivation, passivity in Iron chromium alloys.

Unit – V Corrosion prevention
Cathodic and anodic protection metallic and inorganic surface coating films and adsorption inhibitors. Corrosion rate measurement and analysis of corrosion failures.

Name of Text Books :
- Introduction to Electrometallurgy – Sharan and Narayan
- An Introduction to metallic Corrosion and Prevention - Raj Narain
- Corrosion Engineering – Fontana and Greene

Name of Ref. Books
- Introduction to Electrochemistry – S. Glasstone
- Chemical Metallurgy – J. J. Moore
- Electroplating and related Metal finishing. Pollutant and toxic materials Contrell – Marshal
- Modern Electroplating – Lowenhein
- Corrosion causes and Prevention – Speller
- Diectrochemical Engineering – C.L. Mantel
Unit – I Function of Alloying elements in steel
Limitations of plain carbon steel, General effect of alloying elements, mode of combination of 
alloying elements, Effect of alloy elements on transformation temperature, effect of alloying 
elements on critical cooling rate, on hardenability and on tempering. Low alloy steels:- Low 
alloy steels such as high tensile structural steel, case carburizing steels, nitriding steels, ball 
bearing steels, spring steels, low alloy high strength structural steels.

Unit – II Study of high Ni steels, high speed steel, die steel, Hadfield’s steel and maraging 
steel.

Unit – III Cast Irons:- Structure and properties of white cast irons, gray cast iron, malleable 
cast iron, nodular cast iron and alloy cast irons. Study of Stainless steels, heat resistant high 
strength steels and ausformed steels.

Unit – IV Non ferrous alloys- Structure and properties of Brasses, bronzes, babbits. Structure 
and properties of titanium alloys, Aluminium alloys, Monels, brazing and soldering alloys.

Unit – V Metals at low temperatures:- Effect of low temperature on properties, Effect of low 
temperature on notched bar test, Metallurgical factors, mechanical factors. Magnetic steels 
Amorphous metals. Specifications of alloys:- I S I, A I S I and En standards (Basic concepts 
only).

Text Books
Physical metallurgy for engineers- by D.S. Clark and Warne.
Introduction to Physical metallurgy- by Sidney H. Avner.
Unit – I

Basic Control System in industrial application, scope of computer application in the operations of a manufacturing firm. Product cycle, Automation and CAD/CAM. Microprocessors in instrumentation and control.

Unit – II


Unit – III


Unit – IV

Application of microcomputers to mechanical testing, selection of optimum cost steels and prediction of hardenability, computer analysis of engineering components. Statistical Analysis of metallurgical data.

Unit – V


Names of Text Books:

Unit 1 General principles of materials selection and design based on requirements of function, property, processability and cost.

Unit 2 Quantitative methods of materials selection, normalization of properties, weighting factors, materials performance index.

Unit 3 Introduction to design codes, criteria for material qualification and acceptance for important applications.

Unit 4 Introduction and use of materials data bases, hand books etc. illustrative examples of materials selection

Unit 5 Materials for aircraft wings, cutting tools, gas turbine blades, liquid nitrogen containers, artificial hip replacement, automobile value spring etc.

Texts/References:

Experiment to be performed
1. Study of plant layout of an integrated iron & steel plant
2. Constructional detail of Blast furnace.
3. Designal features of LD converter
4. design & working of regenerators in open hearth furnace.
5. Study of Twin ;Hearth Furnace steel making.
6. constructional detail of Electric arc furnace.
7. Study of atmosphere control in EAF
8. Comparative study of Kaldo and LD steel making.
10. Study of ladle metallurgy (AOD, VOD etc.)

List of Equipments/Machine Required:
1. Charts
2. Models
3. Video clipping
4. Industrial Training
5. Tables
6. Photographs.

Recommended Books:
1. Lab manuals
2. The making Shaping and Treating of Steel
3. Electric furnace steel making volume – I and II
Experiment to be performed

1. Al-alloys making (Y-alloy, duralumin)
2. Study of the structure and interpretation of results of Al-alloys.
4. Preparation of silumin alloys.
5. Study of the microstructure and interpretation.
6. Copper melting and making of brass.
7. Measurements of mechanical properties of copper and its alloys and correlation properties with microstructure.
8. Copper melting and Bronze making.
9. Metallographic studies of Brass
10. Metallographic studies of Bronze.
14. Study of microstructure of cast iron and correlation with mechanical properties.
15. Study of microstructures of steels and correlating with mechanical properties.

List of Equipments/Machine Required:

1. Crucible
2. Heat Treatment furnace
3. Master alloys
4. Metallurgical Microscope
5. Polishing and etching materials/equipments.

Recommended Books:

1. Lab manuals
2. Structures and properties of alloys – by Robert M Brick and Phillips
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: VII
Subject: Electrometallurgy and Corrosion
Total Practical Periods: 40
Total Marks in End Semester Exam: 40
Minimum number of class test to be conducted: 2

Experiment to be performed
1. Copper plating
2. Chromium plating
3. Electroplating of cadmium
4. Electroplating of Zinc
5. Effect of acidity in electrometallurgy
6. Effect of electrode distance in electrometallurgy
7. Effect of circulation in electrometallurgy
8. Brass plating
9. Electrowinning of copper
10. Electrowinning of Zinc
11. Anodizing
12. Corrosion rate measurement (weight loss study)
13. Corrosion reaction and polarization study
14. Effect of Inhibitors on corrosion behavior of steel
15. Electropolishing

List of Equipments/Machine Required:
1. Voltmeter
2. Ammeter
3. Resistors
4. Potentiostate (Automated)
5. Required chemicals, CuSO4, H2SO4, etc.
6. PH measuring instrument
7. Required metals, copper, zinc, steel etc.

Recommended Books:
1. Lab manuals
2. Electroplating and related metal finishing, pollutant and toxic materials, Contrell Marshal
Unit I
Innovation: innovation- an abstract concept; creativity, innovation and imagination; types of innovation -classified according to products, processes or business organizations.

Unit II
Entrepreneurship: who is an entrepreneur? Entrepreneurship- A state of Mind, Emergence of entrepreneur; Role of Entrepreneur; A Doer not a Dreamer- Characteristics of an entrepreneur; Factors affecting entrepreneurial growth – Social, cultural, personality factors, psychological and Social Factors. Impact of Entrepreneurship for sustainable development.

Unit III
Difference between entrepreneur and entrepreneurship, Difference between entrepreneur and intra-preneur, Common Entrepreneurial competencies/Traits; Entrepreneurship stimulants, Obstacles inhibiting Entrepreneurship; Types of entrepreneurs, Functions of an entrepreneur.

Unit IV

UNIT-V

Text and Reference Books:
1. Competing through Innovation-Bellon & Whittington, Prentice Hall of India
3. Entrepreneurship- Rober D Hisrich, Peters, Shepherd- TMH
4. Entrepreneurship in Action- Coulter, Prentice Hall of India
5. Entrepreneurship Management and Development – Ajith Kumar, HPH
6. Fundamentals of entrepreneurship- Mohanty, PHI