## Chhattisgarh Swami Vivekanand Technical University, Bhilai
### Scheme of Teaching and Exam

### 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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>Theory/practical Marks</td>
</tr>
<tr>
<td>1</td>
<td>Metallurgical Engineering</td>
<td>338731(38)</td>
<td>Foundry Technology</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Metallurgical Engineering</td>
<td>338732(38)</td>
<td>Deformation behavior of Materials</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Metallurgical Engineering</td>
<td>338733(38)</td>
<td>Corrosion and Degradation of Materials</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Metallurgical Engineering</td>
<td>338734(38)</td>
<td>Alloys Their Properties and Selection</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Refer Table – II</td>
<td></td>
<td>Professional Elective – II</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Metallurgical Engineering</td>
<td>338761(38)</td>
<td>Foundry Technology Lab</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Metallurgical Engineering</td>
<td>338762(38)</td>
<td>Alloys and Their Properties and Selection Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Metallurgical Engineering</td>
<td>338763(38)</td>
<td>Corrosion and Degradation of Materials Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Metallurgical Engineering</td>
<td>338764(38)</td>
<td>Minor Project</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Management</td>
<td>338765(76)</td>
<td>Innovative and Entrepreneurial Skills</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>Metallurgical Engineering</td>
<td>338766(38)</td>
<td>**Practical Training Evaluation and Library</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>5</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</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**

**Table - II**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Metallurgical Engineering</td>
<td>338741 (38)</td>
<td>Alternative Routes of Iron and Steel Making</td>
</tr>
<tr>
<td>2</td>
<td>Metallurgical Engineering</td>
<td>338742 (38)</td>
<td>Design and application for Engineering Materials</td>
</tr>
<tr>
<td>3</td>
<td>Metallurgical Engineering</td>
<td>338743(38)</td>
<td>Ferro Alloy Technology</td>
</tr>
</tbody>
</table>

**Note:** (1) - 1/4th of total strength of students subject to minimum of twenty students is required to offer in elective in the

**Note:** (2) - Choice of elective code once made for an examination cannot be changed in future examinations.
CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI (C.G)

Semester: VII
Subject: Foundry Technology
Branch: Metallurgical Engg.
Total Theory Periods: 40
Total Marks in End Semester Exam: 80
Minimum number of class test to be conducted: 2

COURSE OBJECTIVES

• To learn the basic principles of solidification of metals and foundry technology.
• To utilize the knowledge for industrial application
• Apply basic scientific principles for technical problem solving in foundry to increase Technical Skills

Unit – I
Solidification of pure metals and alloys, parameters affecting the solidification. Concept of directional and controlled directional solidification and methods to attain directional solidifications, Interendritic shrinkage, center line shrinkage phenomenon in castings, Macro and Micro segregation, gases in castings

Unit – II
Fluid flow principles for melts and Gating system and its design, Design of ingate, sprue, runner, requirements of an ideal gating system, types of gates. Feeders requirements and functions of feeders. Feeder design, Risers. Risering methods, Caine’s method, NRL method, Wlodawer’s process, methods of riser design for various shapes of castings. Construction and design of pattern, pattern allowances, pattern colours. Evaluation of Chvorinov’s equation and its importance in other calculation.

Unit – III
Patterns; Moulding Sands; General Characteristic, ingredients and their effects on properties of moulding sands Testing of moulding sands. Banking and facing sands, sand conditioning. Cores- Function, types, core sands, core binders, core preparation, core was, core supports.

Unit – IV
Moulding and Casting Processes; Various process of molding and casting like green and dry sand core sand, shell moulding, CO2 process, permanent molds. Centrifugal investment, die casting. Moulding equipment, process details and applications.

Unit – V

Text Book and references:
1. Foundry Technology - P.R. Beeley
4. Metal casing. – R.A. Flín

METHODOLOGY

• Lecture, PPT- Presentation, Class Discussions
• Students’ self study
• Tutorial Classes
• Interactions with the respective Faculty
• Industry Visit

EXPECTED OUTCOME

Foundry is one of the most important metal processing techniques. This will help in designing the process as well as solving the practical problems encountered while metal processing
COURSE OBJECTIVES
Deformation behavior of materials is an important criterion for metal fabrication as well to understand the failure of materials during service.

Unit – I

Unit – II
Plastic deformation of single crystals; Deformation by slip, slip by dislocation movement, critically resolved shear stress for slip, deformation by twining. Plastic deformation in polycrystalline material; grain boundaries and deformation, yield point phenomenon and strain aging. Strain hardening and cold work, Bauschinger effect.

Unit – III

Unit – IV

Unit – V

METHODOLOGY
- Lecture, PPT- Presentation, Class Discussions
- Students’ self study
- Tutorial Classes
- Interactions with the respective Faculty
- Industry Visit

EXPECTED OUTCOME
The knowledge will help in the design, metal processing, fabrication and failure analysis.
OBJECTIVE: To understand the principles of electrochemistry, corrosion and metal degradation

UNIT – I
Electro-chemical nature of corrosion. 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
Types of corrosion. Mechanism of high temperature oxidation, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, hydrogen cracking, dezincification.

UNIT – III
Mechanically induced corrosion; stress corrosion cracking, corrosion fatigue, cavitation corrosion, fretting corrosion. Erosion corrosion,

UNIT – IV
Corrosion prevention; Basic principles, effect of design, selection of materials, cathodic and anodic protection metallic and inorganic surface coating, inhibitors. Corrosion rate measurement.

UNIT – V
Root cause analysis of corrosion failures. Corrosion problems in chemical, petrochemical, fertilizer, power plants, steel industries and their solutions.

NAME OF TEXT BOOKS:
Corrosion Engineering – Fontana and Greene

NAME OF REF. BOOKS
• Introduction to Electrochemistry – S. Glasstone
• Chemical Metallurgy – J. J. Moore
• Corrosion causes and Prevention – Speller

METHODOLOGY
• Lecture, PPT- Presentation, Class Discussions
• Students’ self study
• Tutorial Classes

EXPECTED OUTCOME
To design and selection and protection of materials under aggressive environment.
CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY,
BHILAI (C.G)

Semester: VII
Branch: Metallurgical Engg.
Subject: Alloys their properties and Selection
Total Theory Periods: 40
Total Marks in End Semester Exam: 80
Minimum number of class test to be conducted: 2

Code: 338734(38)
Total Tut Periods: 12

Objective: To learn the effect of different alloying element on the steel and understand the concept for production of different alloy steel for appropriate use.

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 steel and managing 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

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

METHODOLOGY
- Lecture, PPT- Presentation, Class Discussions
- Students’ self study
- Tutorial Classes
- Interactions with the respective Faculty
- Industry Visit

EXPECTED OUTCOME
The knowledge of this syllabus will help in the production of alloys steel, cast iron and nonferrous alloys as per the need.
Semester: VII  
Subject: Alternative Routes of Iron and Steel Making  
Total theory Periods: 40  
Total marks in end semester examination: 80

COURSE OBJECTIVE:

To learn the alternative routes of iron and steel making. To be able to design or optimize the emerging processes.

Unit - I
Review of the BF process and its deficiencies of BF. Technical issues limiting the process capabilities; raw material, maintenance, life span and obsolescence, environmental, downstream capabilities, economics. The green steel making technologies. Introduction and categorization of alternative technologies.

Unit – II
Sponge iron processes for production of solid iron/DRI. Coal based processes; Rotary Kiln, Krupp-Renn process, Krupp-CODIR process, SL/RN(Outcompu) process, ACCAR process, DRC process,

Unit – III
Gas based Sponge Iron processes: MIDREX, HYL, Indigenous processes: JINDAL and TDR technology. Fastmet process

Unit – IV
Liquid Iron Making Smelting Reduction processes: COREX, ROMELT, ITmk3 (Nuggets), Hismelt,

Unit - V
New steel making technology: modification of BOF; bottom blowing, combined blowing, Energy Optimization Furnace (EOF), Horizontal continuous casting, Thin slab casting, near net casting, concept of mini integrated steel mills. Steel industries - tomorrow and far future. Indian scenario.

METHODOLOGY

• Lecture, PPT- Presentation, Class Discussions
• Students’ self study
• Tutorial Classes
• Interactions with the respective Faculty
• Industry Visit

EXPECTED OUTCOME

The student will aware of use of appropriate furnace for the production of iron and steel by alternative routes. They will also benefited by applying the above knowledge to modify the furnace for production of same at low cost.
Objective: To learn the concept of design the engineering materials and know the application of designed engineering materials.

Unit-I

Unit -II
Factors in Material Selection. Material Selection using Ashby Method, Multiple Constraints in material selection, Multiple Objectives, The Role of shapes, Selection of Shapes. Co-selection of Materials and Shapes

Unit -III

Unit -IV

Unit -V
Design for Reliability. Case Studies; materials selection for Vehicle Body, aircraft wings, cutting tools, gas turbine blades, artificial hip replacement, automobile value spring etc.

Texts/References:

METHODOLOGY
- Lecture, PPT- Presentation, Class Discussions
- Students’ self study
- Tutorial Classes
- Interactions with the respective Faculty
- Industry Visit

EXPECTED OUTCOME
The concept will help in the selection and designing the engineering material as per the requirement.
COURSE OBJECTIVE:
To learn processes of production and characterization of low melting alloys.

Experiment to be performed
1. Casting of Al alloy
2. Study of the microstructure of Al alloys
3. Determination of the mechanical properties of Al alloys.
4. Study of the microstructure of cast iron
5. Determination of mechanical properties of cast iron
6. Study of the microstructure of steel
7. Determination of mechanical properties of steel
8. Study of the microstructure of Cu based alloys
9. Determination of the mechanical properties of Cu based alloys
10. Study of the microstructure and determination of mechanical properties of HSLA Steel

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

METHODOLOGY
- Practical operation
- Students’ self study
- Industry Visit

EXPECTED OUTCOME
The student will be able to utilize the concept to produce at least low melting alloys and their characterization like metallographic inspection.
Course Objective:
To learn the concept regarding the degradation of materials. To understand the behavior of corrosive environment on the respective materials. The student should learn the handling of equipment used for determination of rate of corrosion.

Experiment to be performed
1. Corrosion rate measurement by weight loss study
2. Corrosion rate measurement by electro-chemical study
3. Study of galvanic corrosion by different combination of metals
5. Corrosion in sulphide environment.
6. Effect of Inhibitors on corrosion behavior of steel
7. Oxidation loss at high temperature
8. Study of corrosion in different industries

List of Equipments/Machine Required:
1. Potentiostate
2. Required chemicals, CuSO₄, H₂SO₄, etc
3. PH measuring instrument
4. Required metals, copper, zinc, steel brass etc.
5. Digital weight balance.
6. High temperature furnaces
7. Optical Microscopes

METHODOLOGY
The student will learn the concept regarding this syllabus by doing experiment in laboratory and industrial visit.

EXPECTED OUTCOME
The student should aware of the effect of corrosive environment and must have mastery in handling the equipment relation corrosion parameter measurement.
Course objective:
To learn the concept of different casting techniques and know the requirement of different foundry appropriate equipment and accessories.

Experiment to be performed:
1. Melting of medium carbon steel in an induction furnace and pouring in a mold
2. Melting in crucible furnace and pouring of Cu castings
3. Melting in a pot furnace and pouring Al/Al alloys castings
4. Calculation of Metal flow rate and velocity using Bernoulli’s Theorem.
5. To design a runner and gates of a mold.
6. To design a feeder head (or Riser system) considering freezing time, freezing range and volume feed capacity
7. Calculation of heat loss from open riser
8. Study of coring (or segregation) during fast cooling of casting.
9. To design for a sand casting considering various important factors
10. Study of defects in castings, their causes and remedy.

List of equipments:
1. Crucible furnace
2. Induction furnace
3. Pot furnace (fuel fired)
4. Met microscope
5. Mechanical testing equipment
6. Non-destructive testing equipment.

METHODOLOGY
The student will learn the concept regarding this syllabus by doing experiment in laboratory and industrial visit.

EXPECTED OUTCOME
By doing the experiment students should have the knowledge of different foundry equipments, their use and different type casting processes.