Course Name - Metallurgy Engineering

Subject – Physical metallurgy

Course Code- MET306

L T P

3 0 4

Total Hrs : 42

Full marks : 100 (80 + 20)

Rationale :

Physical Metallurgy mainly deals with the study of solidification of metals and alloys. Phase equilibrium, macro & micro structures of ferrous and non-ferrous alloys. These Studies will reveal the mechanical and thermal treatment given to the metals and alloys which predict the expected behaviour under a given set of conditions.

Objectives :

The student will be able to

1. Understand the solidification phenomenon of metals and alloys
2. Acquire knowledge of different macro and micro structure of ferrous and non -ferrous metals and alloys.
3. Prepare specimen for macro and micro examination
4. Be familiar with phase diagram including iron- carbon diagram
5. Acquire Knowledge of lever rule and their applications

Contents :

A. Theory

1. Solidification of metal H- 02 M-06

Transformation of liquid into solid, cooling curve, cooling curve for pure metals and binary alloys, nucleation, Grain growth , Dendrite formation.

2. Phase Equilibrium Diagrams **H-8 M-16**

Definition of Phase, Gibbs phase rule and its applications, solid solution, substitution solid solution, Interstitial solid solution, terminal solid solution. Intermediate Solid Solution, Intermediate Compounds, Construction of equilibrium diagram i.e. Monotectic reaction, eutectic reaction, peritectic reaction, Eutectoid reaction, peritectoid reaction.

3. Lever Rule **H-03 M-06**

Derivation of Lever rule and its application to equilibrium diagram. Identification of microstructure of metals at different temperature with respect to equilibrium diagram

4. Iron-Carbon Equilibrium Diagram **H-8, M-14**

Allotropic transformation of iron, Different reaction in iron- carbon phase diagram. Classification, microstructure and properties of Plain Carbon Steel and cast iron with reference to iron- carbon diagram

5. Microscopic Examination **H-04 M-11**

Preparation of sample for viewing microstructure, mechanical and electrolytic polishing, etching techniques and etching reagents

The Metallurgical microscope and met allograph. Optical Principles of metallurgical microscope.

6. Macroscopic Examination **H-03 M-06**

Principles and procedure of macroscopic examination, sulphur printing, Phosphorous printing

7. Quantitative Metallography **H-03 M-06**

Measuring attachment on microscope, calibration measurement of grain size. ASTM grain size Nos. Measurement of case depth, plating thickness etc.

Importance of phase distribution in microstructure and its effect on mechanical properties.

8. Metallurgy of Non- ferrous alloys H-11 M-14

A . **Brasses:-** Cu-Zn equilibrium diagram. Brasses microstructures. Single phase and double phase brass. Mechanical properties and application of commonly used industrial brasses

B. **Bronzes:-** Cu-Sn equilibrium diagram, Composition, microstructure mechanical properties and application of commonly used industrial bronzes, Gun metal and phosphor bronzes.

C. **Al-alloys:-** Al-Cu equilibrium diagram, solution hardening of duralumin alloy

D. **Bearing Metal-** Classification of bearing metals, requirements of good bearing metals, composition microstructure, mechanical properties and application of lead base and tin base bearing metal. Effect of Cu addition in lead base and Tin base bearing metal

Physical Metallurgy Lab :-
Subject Code :- MET309

List of Experiments

1. Preparation of sample for microscopic examination.
2. Practical on electric polishing and etching.
3. Study of etching technique.
4. Study of metallurgical microscope.
5. Practical on microscopic Examination
6. Experiment on measurement of ASTM grain size.
7. Study of microstructure of ferrous metal and alloys.
8. Study of microstructure of non-ferrous metal and alloys
9. Practical on sulphur printing
10. Practical on Phosphorous printing
11. Practical on microphotography.

References Books

1. Physical Metallurgy Principles by Reed Hill
2. Metallurgy for Engineers by E.C. Rollason
3. Introduction to Physical Metallurgy by S.H.Avner
4. Engineering Physical Metallurgy by Y. Lakhhtin
5. Metallurgical Laboratory Practice by Dr. Khel