

**BHAGWAN MAHAVIR COLLEGE OF ENGINEERING
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AUTOMOBILE DEPARTMENT**



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ASSIGNMENTS

Assignment 1

Introduction to Material Science Metallurgy

1. Classify the engineering materials. Explain any two of them.
2. Differentiate between Micro and Macro examination of engineering metallic materials? Completely describe the procedure for “specimen preparation for microscopic examination”.
3. State the importance of study of “Material Science” and briefly explain engineering requirement of materials.
4. Explain Structure Property and Performance relationships with a suitable example.

Assignment 2

Crystal geometry and Crystal Imperfections

1. Differentiate between Edge and Screw dislocation.
2. Draw a unit cell and show the following planes (a) (113) (b) (102) (c) (111) and (d) (001).
3. Explain imperfections in crystal with neat sketches.
4. What are the various levels of structure? Explain in detail.
5. What are slip bands and slip lines? Draw required sketches. What causes the formation of such bands on a metal surface.
6. Explain and differentiate Edge dislocation and Screw dislocation with neat sketch.

Assignment 3

Plastic Deformation

1. What is twinning deformation? Explain the difference between slip and twinning mechanisms using sketch.
2. What is strain hardening? Explain how the effect of strain hardening can be eliminated by recrystallization?

Assignment 4

Solidification of metals and an alloy

1. Explain in detail, the solidification of an ingot/casting giving sketches of all important zones produced as a structure of ingot/casting.
2. Explain the phenomenon of “Coring”.
3. Compare cooling curves for pure metal, isomorphous and non-isomorphous alloys. State the information revealed by these cooling curves.
4. Differentiate under-cooling and constitutional super-cooling in context of solidification and its effect on final structure.
5. Explain the three basic zones formed after solidification of alloys.
6. What are the various methods of controlling grain structure during solidification? Explain in detail.
7. Differentiate between Homogeneous and Heterogeneous nucleation processes. Also discuss the conditions under which growth may be of planar and dendritic type. OR Explain homogenous and heterogeneous nucleation with neat sketches
8. What is critical nucleus? In case of crystallization of metals, what is the difference between an embryo and a nucleus. What is the significance of critical radius of a solidifying particle?

Assignment 5

Phase and Phase equilibrium

1. State the “Gibbs phase rule”. Using this rule prove that degree of freedom at eutectic point in a binary phase diagram is zero.
2. What is Gibbs Phase Rule ? Clearly explain all variables .
3. Explain substitutional solid solution and Hume Rothery Rule for the feasibility of it.
4. What is substitutional and interstitial solid solution. Why solubility of solute is limited in interstitial solid solution? Justify.
5. Using Gibb’s phase rule, explain unary phase diagram with the help of sketch.
6. What is cooling curve? Explain and differentiate time temperature cooling curve of an alloy of eutectic composition and pure metal.
7. What is phase diagram? Explain Lever rule.

Assignment 6

Allotropy of Iron, Iron-Iron-Carbide equilibrium system-phases

1. Explain the phenomenon of “Allotropy” by giving a suitable example. **OR** What do you mean by allotropy of metal? Discuss allotropy of Iron.
2. State critical reactions of Iron Carbon phase diagram.
3. Draw and explain microstructure of eutectoid steel.
4. Draw iron – iron carbide equilibrium diagram. Explain important phases in it. Discuss the phase transformation takes place for the 0.6 % carbon steel from liquid to room temperature.
5. Draw a neat and labeled Iron-Iron Carbide diagram and explain eutectic and eutectoid reaction in it.
6. Draw and label TTT diagram for eutectoid steel and show annealing and normalizing in it. Explain the critical cooling rate with the help of TTT diagram.
7. Explain the steps to obtain the TTT-diagram for eutectoid steel and show on it the cooling curve representing annealing and hardening process.
8. Write a short note on: “Iron-iron carbide equilibrium diagram”.
9. With the aid of an iron- iron carbide equilibrium diagram show and explain eutectic, peritectic and eutectoid transformation. Also mention the significance of these transformations

Assignment 7

Heat Treatment of Steels

1. Evaluate: Annealing is never a final heat treatment process for hypereutectoid steel. Compare and contrast the Annealing with Normalizing process.
2. Justify the need of Heat treatment processes for metals. Explain with neat sketch TTT diagram for heat treatment of steel. **OR** Define Heat treatment of metals. Explain with neat sketch TTT diagram for heat treatment of steel
3. Differentiate between Annealing process and Normalizing process.
4. State Surface Hardening processes and explain any one.
5. Describe and compare Austempering and Martempering.

Assignment 8

Alloy steels

1. What is Alloying? Explain the effects of chromium as an alloying element.
2. What is the metallurgical explanation of effects of chromium, nickel, molybdenum, and carbon in stainless steels?
3. What are the purpose of Alloying? Give effects of nickel as an alloying element.
4. What is plain carbon steel? Also explain all type of plain carbon steel with the composition and specific application.

Assignment 9

Cast Iron

1. Draw the microstructure of white cast iron and enlist its properties
2. Differentiate between white cast iron and grey cast iron.
3. Classify different types of cast iron. Why silicon is added to cast iron?
Explain the effects of any four alloying elements on the properties of cast iron.
4. State composition, specific properties and applications of Grey Cast Iron.

Assignment 10

Non-ferrous alloys

1. Explain following alloys giving their important constituents & Applications: (I) Monel (II) Invar (III) Nichrome.
2. State the Qualities Required in Bearing Metals. **OR** Explain the property requirement from a bearing material. Explain journal bearing material in detail
3. State composition and specific applications of :
Muntz metal ; German silver ; Naval brass
4. Enlist the properties of pure aluminum and mention the composition, properties and application of any one aluminum alloy.

Assignment 11

Powder Metallurgy

1. Enlist methods of manufacturing metal powder. Describe any one in detail.
2. Define Powder Metallurgy. State advantages, limitations and applications of Powder Metallurgy.
3. What is Powder Metallurgy? Explain the process of Powder Metallurgy.
4. Completely describe the “Sintering Process”.
5. Enlist the products made from powder metallurgy. Explain all four steps of powder metallurgy.
6. Enlist methods of manufacturing metal powder. Discuss any one in detail.
7. Explain the requirements of metal powders used in powder metallurgy. Also explain various methods of powder production.

Assignment 12

Non-Destructive testing of materials

1. What is non-destructive test? List various nondestructive tests. Explain general advantages and disadvantages of non-destructive tests.
2. Explain the Eddy current Method of Testing with neat sketch. Also explain its benefits and limitations.
3. Compare Destructive test with Non Destructive test. **OR** Differentiate destructive and non-destructive testing by stating benefits and limitations.
4. Explain Dye penetrant testing.
5. Explain the method Ultrasonic Testing with neat sketch. And also explain its advantages and limitations.

Assignment 13

Metallography

1. What is metallography? What useful information can be obtained from it?
2. Describe with neat sketch how would you carry out a Jominy harden ability test on a steel sample.