Valliammai Engineering College

Department of Mechanical Engineering

ME 6403 Engineering Materials and Metallurgy

Regulation 2013

Question Bank

Unit-1- Constitution of Alloys and Phase Diagrams

Part-A

1. When will interstitial solid solution occur?
2. What is isomorphous?
3. How is plain carbon steels classified? Define an alloy?
4. Classify the alloys.
5. What are solid solutions?
6. Differentiate substitutional and interstitial solid solutions with examples.
7. What are intermediate phases?
8. Define the term phase.
9. What is an equilibrium phase diagram?
10. Define eutectic reactions?
11. Define peritectic reactions?
12. Define eutectoid reactions?
13. Define peritectoid reactions?
14. Distinguish eutectic and eutectoid transformations.
15. Distinguish peritectic and peritectoid transformations.
16. What are the uses of grey cast iron?
17. What are chilled cast irons?
18. Why nodular cast iron is called ductile cast iron?
19. What are the advantages of alloy steels over plain carbon steels?
20. What is the effect of additions of chromium on the characteristics of steel?

Part-B

1. Show the different steel and cast iron region in the iron carbon diagram with its microstructure and write down its composition, mechanical properties and application.
2. Draw a neat sketch and explain TTT diagram.
3. Draw Iron carbon diagram and label all fields?
4. Draw a typical equilibrium diagram for an isomorphous system and explain the equilibrium cooling of any one alloy from the above diagram.
5. Draw a typical equilibrium diagram for a eutectic type of system with limited solid solubility and explain its important features.
6. Explain the Peritectic temperature using a binary equilibrium peritectic phase diagram
7. What is the effect of small quantities of

   (a) Sulphur

   (b) manganese

   (c) phosphorus

   (d) Silicon upon the properties of steel?
8. Explain the method of plotting an equilibrium diagram and derive the lever rule as applied to equilibrium diagram.
9. Discuss the effect of Silicon, Manganese elements in cast iron.
10. Describe the composition, microstructure, properties and applications of grey cast iron.

Unit-II HEAT TREATMENT

Part-A

1. Name various methods of heat treatment of steel.
2. When the annealing process is preferred?
3. Define full annealing.
4. Define heat treatment.
5. What is martensite and for eutectoid steel in what temperature range it is generally formed?
6. What is the purpose of spheroidising annealing?
7. Define normalizing.
8. What is the purpose of normalizing?
9. What are the factors affecting the hardening process?
10. What is austempering process and what is the microstructure produced after austempering?
11. What is martempering process and what is the purpose of this treatment?
12. Distinguish between hardness and hardenability.
13. Define carburizing.
14. What are the three methods of carburizing commonly employed?
15. What is the purpose of flame hardening and induction hardening of steel?
16. Name the four different methods used for flame hardening.
17. what steels are commonly used for nitriding?
18. What is the process of nitriding?
19. Define cyaniding.
20. What is the process of carbonitriding?

Part-B

1. Describe the method of plotting isothermal transformation or TTT diagram?
2. Draw an IT diagram or TTT diagram for an eutectoid steel .Indicate the various decomposition products on it and explain?
3. Draw a schematic CCT diagram for a carbon steel containing 0.8% C .Using this diagram explain how different cooling curves lead to the

   (a)Annealing heat treatment

   (b) Normalizing heat treatment

   (c) Hardening heat treatment
4. Explain how Jominy end quench test is used for determining the harden ability of steels.
5. Describe the heat treatment cycle following carburizing.
6. Describe the process of carbonitriding. Differentiate between carburizing and carbonitriding.
7. Explain flame hardening.
8. Explain Induction hardening.
9. Give a detailed account on

   (a) Annealing (b) Normalizing (c) Austempering

   (d) Case hardening.
10. Explain how surface hardening is achieved using flame hardening.

Unit-III Ferrous and Non Ferrous Metals

Part-A

1. What is the effect of chromium alloying element on the properties of steel?
2. What is cast iron?
3. What is HSLA?
4. What are advantages of alloy steels over plain carbon steels?
5. Discuss the general effects of alloying elements in steel.
6. Specify the effect of nickel on the properties of steel.
7. What advantages are derived by using a combination of nickel and chromium in steel?
8. What are the principal alloying elements in triple alloy steel?
9. How is silicon useful as an alloying element in steel?
10. For what purpose is tungsten used in steel?
11. What are stainless steels? Why are these steels stainless?
12. What type of stainless steels is referred to as ferritic stainless steels?
13. What are tool steels? Classify them.
14. List the bearing materials that are commonly used?
15. What is meant by precipitation hardening?
16. What is duralumin?
17. Give composition and applications of duralumin?
18. List at least four types of brasses used.
19. List some bronze alloys.
20. How can you classify tool steels?

Part-B

1. Write short note on compositions and properties of the following stainless steels,
   (a) Ferritic stainless steel
   (b) Austenitic stainless steel
   (c) Martensitic stainless steel
   (d) Precipitation hardening stainless steel
2. State the types, compositions and properties of high speed steel.
3. Discuss Hadfield and Mar aging steels on the following lines
   (a) Chemical composition
   (b) Heat treatment
   (c) Mechanical properties
   (d) Applications
4. Explain the various methods to achieve high strength in HSLA steels.
5. Explain Bearing alloys.
6. Explain Tool steels.
7. Name different alloys of copper. Give its composition, properties and uses.
8. Explain Mar aging steels.
9. Explain Stainless steels, High speed steels.
10. Explain, bearing metals, Explain brasses

Unit-IV NON METALLIC MATERILS

Part-A

1. What is PTFE?
2. What is PE?
3. What is PS?
4. Define the degree of polymerization.
5. What is PVC?
6. What is copolymerization?
7. What is PMMA?
8. What is PET?
9. What is ABS?
10. What is PI?
11. What is PAI?
12. What is PPO?
13. What is PPS?
14. What is PEEK?
15. What is PTFE?
16. What is PA?
17. What is PP?
18. What are acrylics? Mention their application.
19. Distinguish between hard and soft glasses.
20. How is alumina ceramics produced?

Part-B

1. Explain the properties and application of the PVC,PE, PTFE, ABS
2. Give the detailed account on:
   (a) Urea formaldehydes
   (b) Fibre reinforced plastics
   (c) Cellulose nitrate.
3. Explain PMMA.
4. What is polymerization? Describe addition polymerization and condensation polymerization.
5. How plastic materials are classified? Explain each classification.
6. Write brief notes on following traditional ceramics
   (a) Clay products
   (b) Glasses
   (c) Cements
   (d) Refractory's
7. Describe the properties and applications of following structural ceramics
   (a) Alumina
   (b) Partially stabilized zirconia
   (c) Silicon carbide (d) Silicon nitride (e) Sialon
8. Describe the structures, properties and applications of following commodity thermoplastic polymers
   (a) Polyethylene
   (b) Polyvinylchloride
   (c) Polystyrene
9. Describe the strictures, properties and applications of the following commodity thermoplastic polymers
   (a) Acrylonitrile Butadiene Styrene
   (b) Polytetrafluoroethylene
   (c) Nylons
   (d) Polycarbonates
   (e) Polyethylene terephthalate
10. Describe the structures, properties and applications of the following thermoset polymers
    (a) Phenol formaldehyde
    (b) Urea formaldehyde
    (c) Epoxies
    (d) Unsaturated polyesters

Unit-V MECHANICAL PROPERTIES AND TESTING

Part-A

1. Name the slip plane and slip direction for FCC crystal.
2. What is creep?
3. Define slip.
4. Name different types of facture.
5. What properties are determined from tensile testing of metallic products?
6. Distinguish between resilience and toughness.
7. Draw typical engineering stress strain curves for the following materials: (a) Aluminum (b) Mild steel (c) Cast iron (d) Polymer
8. What do you mean by 'double shear' test?
9. Define the hardness of a material.
10. State the advantage and limitation of Rockwell hardness test over the Brinell and Vickers hardness test.
11. Differentiate between Charpy and Izod test results not useful in design?
12. What is fatigue test S-N curve?
13. Define endurance limit in fatigue test.
14. Define fatigue strength in fatigue test.
15. Differentiate between elasticity and plasticity.
16. Differentiate between ductility and malleability.
17. Define the terms brittleness and hardness.
18. How can you prevent the brittle fracture?
19. What is meant by creep fracture?
20. Sketch a creep curve explaining different stages of it.

Part-B

1. Describe with neat sketch fatigue test.
2. Describe with neat sketch creep test.
3. Explain the mechanism of plastic deformation by slip and twinning with neat sketch.
4. Describe how the torsion test is conducted and what are the properties deter from this test?
5. Explain the testing procedure for Vickers hardness test and mention the advantages and limitations.
6. Describe the procedure of Charpy impact testing and the properties obtained from it.
7. Explain the method of testing the materials for fatigue and how is the fatigue data presented.
8. Draw a typical creep curve and explain the various stages of creep.
9. What is meant by ductile fracture? Explain the mechanism of it.
10. Compare and contrast the Brinell, Vickers and Rockwell hardness tests.