



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	PRINCIPLES OF MATERIAL SELECTION
Course Code	AME807
Class	B.Tech
Semester	V
Year	2019-2020
Team of Instructors	Dr. K Ch Apparao, Associate Professor

Objectives

I	Understand the physical and mechanical, metallurgical engineering concepts for metals and preparation of alloys.
II	Analyze the microstructures of metals, alloys and relationship to heat treatment.
III	Understand various criteria for selection of materials for different applications

TUTORIAL QUESTION BANK

S.No	Question	Blooms Taxonomy Level	Course Learning Outcome
UNIT-I			
SELECTION CRITERIA			
Part - A (Short Answer Questions)			
1	What is a “crystalline” material?		
2	What is a single crystal?		
3	State any two applications where single crystals are used.		
4	What is a polycrystalline material?		
5	What is a liquid crystal material?		
6	What is an amorphous material?		
7	Define Crystallography and Explain Unit Cell		
8	Define unit cell and Space lattice with a neat diagram.		
9	Define space lattice with a neat diagram.		
10	What is grain? Explain the concept of grain boundary.		
11	Explain miller indices. Draw the miller indices plane for (100).		
12	Explain miller indices. Draw the miller indices plane for (101).		
13	Define miller indices. Draw the miller indices plane for (110).		
14	Define Dislocation?		
15	What is a polycrystalline material?		
16	Define the term Intermediate phase.		
17	What are imperfections in crystals? Explain Point defect with a diagram?		
18	What is defect? Explain Line defect with a neat diagram?		
19	Classify the line defects. Define Surface defect?		
20	What is Volume defect? Explain volume defect with neat sketch.		
Part - B (Long Answer Questions)			
1	Why is it important to consider the structure of a material while designing and fabricating engineering components?		
2	What is the difference between the microstructure and the macrostructure of a material?		
3	Compare and contrast metallic and covalent primary bonds in terms of (a) the nature of the bond, (b) the valence of the atoms involved, and (c) the ductility of the materials bonded in these ways.		
4	Explain about crystalline material? Distinguish between single crystal material and polycrystalline material?		
5	Explain the procedure to find out the miller indices with an example.		
6	Define the terms (i) Space lattice (ii) Unit cell (iii) Solid solution and monotectic solution.		
7	Define the following terms: (a) composition, b) structure, (c) synthesis, (d) processing, and (e) microstructure.		
8	Explain the difference between the terms materials science and materials engineering.		
9	What is the type of bonding in diamond? Are the properties of diamond commensurate with the nature of bonding?		
10	Explain about effective number of atoms? Calculate the effective number of atoms in SC structure, FCC structure, and BCC structure.		
11	Describe one technique which can be used for crystal structure determination with neat diagram.		

	Discuss the associated law applied during crystal structure.		
12	Write about relation between a, b, c and α , β , γ in cubic crystal system, tetragonal crystal system, orthorhombic crystal system and Hexagonal crystal system.		
13	What are point defects? Explain in detail		
14	Describe about linear atomic density? Calculate the linear atomic density in [110] direction in the copper crystal lattice in atoms per mm. copper is FCC and has a lattice constant of 0.351.		
15	Explain why there is no face-centered tetragonal Bravais lattice.		
16	What are the different polymorphs of zirconia?		
17	What are the Miller indices of the slip planes in FCC unit cells that include the {110}		
18	slip planes in BCC unit cells that include the [111] slip direction?[101] slip direction?		
19	What do you mean by crystal imperfections? What is its importance in deformation mechanism? Discuss briefly its types with suitable sketch.		
20	Compute the following and represent these first three quantities by neat stress-strain diagram (i) Modulus of elasticity of steel (ii) The ultimate tensile strength (iii) The yield stress (iv) The percentage elongation (v) The Percentage reduction in Area .		

UNIT-II

FERROUS MATERIALS

Part - A (Short Answer Questions)

1	What is iron – carbon equilibrium diagram?		
2	Give the uses of iron – carbon equilibrium diagram.		
3	Recall the invariant reactions involved in iron-carbon phase diagram?		
4	What is eutectic reaction in iron – carbon phase diagram?		
5	What are types of steel in iron – carbon phase diagram?		
6	What are eutectoid, hypoeutectoid and hypereutectoid steels?		
7	What are alloy steels?		
8	Recall the purpose of adding other elements to plain carbon steel?		
9	List out the effects of alloying elements in steel.		
10	Mention the classification of alloying elements.		
11	What is phase transformation?		
12	List out the types of phase transformation in ferrous alloys.		
10	Give the example for phase transformation		
14	Give the example for phase transformation		
15	How tempering process is carried out?		
16	What is steel? Mention its types		
17	What is low carbon steel?		
18	Give the applications of low carbon steel.		
19	How alloy steels are classified?		
20	What are the types of cast iron?		

Part - B (Long Answer Questions)

1	Explain microstructural changes that takes place in steel during cooling		
2	Explain hypoeutectoid and hypereutectoid steels.		
3	What are cast irons? How are they formed? Discuss about their microstructure.		
4	Explain different grades and composition of stainless steel with example. Discuss their applications		
5	Classify steel. Explain about the structure and properties of plain carbon		

	steel.		
6	What are carbon composites? Discuss about their micro structure and properties.		
7	What is cryogenic treatment? How is it done for the alloys? Discuss		
8	Give the names properties and uses of different cast irons.		
9	Discuss about the gray cast iron, malleable cast iron and spheroidal graphite iron		
10	What are the different types of cast irons? Explain using a sketch		
11	What are ferrous and non-ferrous materials? Give suitable example. Enlist specific applications for each types of the aforesaid materials.		
12	Name, explain the properties and applications of any four type of ceramics.		
13	(i) Give the properties and uses of any one fibre reinforced composite and particle reinforced composite. (ii) State the law of mixtures in composites.		
14	How are composites classified based on the matrix phase. Compare them based on their properties and applications.		
15	What is strengthening mechanism? Explain the strengthening mechanism of fibre reinforced composites		
16	Write a short note about different types of matrix material and reinforced material used to make polymer matrix composites.		
17	Discuss the effect of dislocation on strength of material, particularly during deformation		
18	Explain the effect of alloying elements on Iron-iron carbide equilibrium diagram		
19	Explain the following reactions: (a) Eutectic (b) Eutectoid (c) Peritectic (d) Peritectoid		
20	Discuss Normalizing as heat treatment process and mention the applications		

UNIT-III

NON-FERROUS MATERIALS

Part – A (Short Answer Questions)

1	Why are aluminium and its alloys more ductile than the magnesium and its alloys?		
2	What are the criteria for selection of materials?		
3	What is the difference between brass and bronze?		
4	What are some of the important properties of copper?		
5	What is brass?		
6	What is bronze?		
7	Why is the Statue of Liberty green?		
8	What is a refractory metal or an alloy?		
9	Define heat treatment.		
10	Name the various methods of heat treatment.		
11	What are the purposes of full annealing?		
12	Differentiate between stress - relief annealing and recrystallization annealing		
13	Define critical cooling rate (CCR)		
14	What are super alloys?		
15	What are the primary effects of chromium and copper as alloying elements in steel?		
16	Give the composition of the following non – ferrous alloys (a) Gunmetal (b) Babbit metal		
17	What are the types of bronze?		
18	What is gilding metal and what are some of its applications?		
19	Give the objectives of heat treatment of metals and alloys		
20	What are the objectives of annealing process?		

Part - B (Long Answer Questions)

1	Discuss the benefits and disadvantages of aluminum alloys as a replacement for structural steels in ships.		
2	Assuming that the density remains unchanged, compare the specific strength of the 2090-T6 aluminum alloy to that of a die cast 443-F aluminum alloy		
3	Would you expect a 2024-T9 aluminum alloy to be stronger or weaker than a 2024-T6 alloy? Explain.		
4	Explain how pure copper is made?		
5	Compare the percent increase in the yield strength of commercially pure annealed aluminum, magnesium, and copper by strain hardening. Explain the differences observed.		
6	Discuss about the structure and properties of Aluminium and its alloys.		
7	Explain about various hardening methods in use for alloys		
8	Discuss about the structure and properties of titanium and its alloys.		
9	Write briefly on the characteristics and properties of the following alloys: (a) Titanium alloys. (b) Al-alloys.		
10	List five suitable applications where eutectic alloys are used.		
11	Explain briefly about classification of steels.		
12	Discuss about Cupronickels and Beryllium Bronze alloys		
13	Draw an equilibrium diagram for a Cu-Ni system to scale and label all the points. Explain its important features.		
14	Discuss about the structure and properties of titanium and its alloys.		
15	Discuss effect of Construct Thermal Equilibrium Diagram of non-ferrous alloys. Mention and interpret the same.		
16	Draw an equilibrium diagram for a Cu-Ni system to scale and label all the points. Explain its important features.		
17	Explain Ni based super alloys and Ti alloys		
18	Discuss the composition, properties and typical application of any four copper alloys		
19	Explain the composition properties and typical application of some aluminium alloy?		
20	Why non-ferrous metals are used in industry in spite of their higher cost in comparison with ferrous metals?		

UNIT-IV**COMPOSITES****Part - A (Short Answer Questions)**

1	Define composite material		
2	What is the need for composite material?		
3	What is composite material ? Explain with classification and types		
4	Mention important characterits of composite material		
5	Give examples for fiber material		
6	Mention important matrix materials		
7	Define lamina		
8	Write the generalized Hooks Law for composite materials		
9	What is the role of matrix is a composite material?		
10	What is the role reinforcement in composite materials?		
11	What are the advantages of composite materials?		
12	Give examples use of composite materials.		
13	What are various types of Matrices used in FRP?		
14	Write the compliance matrix for plane stress.		
15	Write transformation matrix for an angle-ply matrix		

16	Write the laminate stress-strain relation in material coordinate.		
17	Write structural strain relation for laminates.		
18	Write the various engineering applications of composites.		
19	List types of fibres used in FRP.		
20	Discuss significance of A, B, D matrices.		

Part – B (Long Answer Questions)

1	Explain about various methods of component manufacture of composites. Define composite material. List the functions of the following: (i) Matrix material. (ii) Reinforcement materials.		
2	Briefly explain about carbon-carbon composites and hybrid composites.		
3	What is the significance of polymers matrix material in fibre-reinforced composites? Explain briefly. Explain briefly about the properties of ceramics.		
4	What are plastic materials? What are its various classifications? List one example. Application for each types.		
5	What do you mean by the term Polymer? ? Explain with types, characteristics and applications.		
6	What do you mean by the term 'ceramic' ? Explain with types, properties and application.		
7	Describe stress strain relations for a lamina of arbitrary orientation.		
8	What are the commercial forms of fibers?		
9	Explain with neat sketches the production of carbon fibers.		
10	What are the functions and desirable properties of resins		
11	Discuss the desirable properties of matrix materials		
12	What are the advantages and disadvantages of composite materials		
13	Discuss any one liquid state processing of MMCs with neat sketch.		
14	Write a note on any one metallic alloys used in MMCs.		
15	Discuss the benefits of reaction bonding process of CMCs.		
16	With a schematic diagram explain slurry infiltration technique used for fabrication of ceramic matrix composites.		
17	Discuss the lanxide process for the fabrication of ceramic matrix composites.		
18	Distinguish polymer and ceramic with respect to mechanical and physical properties.		
19	Highlight any six advantages of MMCs over PMCs.		
20	Write a short note on slurry infiltration process with a neat sketch.		

UNIT- V

WEAR RESISTANCE ALLOYS

Part - A (Short Answer Questions)

1	Define plastics		
2	What are the thermosetting polymers?		
3	Name two refractory materials.		
4	List any four attractive characteristics of polymers. Define Slip and Twinning types of deformation		
5	What are the sources of raw materials for plastics?		
6	What do you mean by copolymers?		
7	What is polymer?		
8	What are elastomers?		
9	What are thermosets?		
10	Write short notes on zinc blend structure?		

11	What are some of the polymers that you encounter every day? Describe their physical properties.		
12	Why are olefins (alkenes) good monomers for polymerization reactions?		
13	What is the difference between a heterogeneous and a homogeneous catalyst? What are some of the advantages of homogeneous catalysts		
14	What is the nature of the bonding interaction between a metal and an olefin?		
15	Why are metals often good catalysts?		
16	What is suspension polymerization.		
17	What is Polymerization reactor		
18	Classify different of polymers		
19	What is homogeneous catalyst		
20	What is polymerization reactions?		
Part - B (Long Answer Questions)			
1	Compare thermosetting and thermoplastic matrix material.		
2	List the properties and typical application of the following thermoplastics [a] PTFE [b] PMMA[c] PET [d] PEEK [e] PE		
3	Write on engineering brief about the flowing thermoplastics; [a] polyethylene[b] Polyvinyl chloride [c] Acetyl [d] polyamide		
4	Explain the difference between commodity plastics and engineering plastics.		
5	Describe the molecular structures properties and application of the following polymers.		
6	Give a detailed account on: [a] urea formaldehyde [b] fibre rain forced plastics [c] cellulose nitrate		
7	Explain the following terms with respect to polymers (1) Mechanical behavior (2) Thermal behaviour (3) Electrical behaviour.		
8	What are the special properties of plastics that make them suitable for engineering applications? Describe the concept of 'Co-polymerization'.		
9	Discuss the structure and applications of any four thermoplastic and any four thermoset plastic materials.		
10	What are the fibre reinforced plastics? Name any four fibres and their matrix material.		
11	What is polymerization? Describe addition polymerization and condensation polymerization.		
12	How are the polymer classified on the basis of structure?		
13	Write the free radical polymerization of ethane.		
14	Give the structure of repeating unit of following polymers: (a) butyl rubber (b) kevlar		
15	Discuss the effect of cross linking and branching of the chains on the properties of polymers		
16	what do you understand by functionality of monomer? explain with example		
17	differentiate between homopolymers and copolymers with suitable example		
18	How do you explain the functionality of monomer?		
19	Low density polythene and high density polythene , both are polymers of ethene but there is marked difference in their properties . Explain		
20	Write a note on kinetic chain length in free radical polymerization		

Prepared by:

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