



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	METALLURGY AND MATERIAL SCIENCE
Course Code	:	A31803
Class	:	II B. Tech I Semester
Branch	:	MECH
Year	:	2016 – 2017
Course Coordinator	:	Dr. KGK Murti, Professor Dr. NN Ramesh, Professor
Course Faculty	:	Dr. KGK Murti, Professor Dr. NN Ramesh, Professor

OBJECTIVES:

Metallurgy and material science subject is backbone to mechanical engineering discipline. The students are given inputs on fundamentals of crystallography, microstructures and relation to properties of materials. Also students acquire knowledge on phase diagrams, heat treatment which will enable them to select materials for industrial applications. Inputs are also planned on ceramics, glasses, polymers and composites as present day designs are based on many advanced materials.

S No	QUESTION	Blooms taxonomy level	Course Outcomes
UNIT – I STRUCTURE OF METALS			
Part - A (Short Answer Questions)			
1	Define Crystallography	Understand	1
2	Define unit cell	Understand	1
3	Define space lattice	Understand	1
4	Define alloy	Understand	1
5	Define grain boundary	Understand	1
6	Draw the miller indices plane for (100)	Analyse	1
7	Draw the miller indices plane for (101)	Analyse	1
8	Draw the miller indices plane for (110)	Analyse	1
9	Draw the miller indices plane for (111)	Analyse	1
10	Draw the miller indices plane for ($\bar{1}10$)	Analyse	1
11	What is Point defect	Remember	1
12	What is Line defect	Remember	1
13	What is Surface defect	Remember	1
14	What is Volume defect	Remember	1

15	What is Dislocation	Remember	1
16	Define Alloy	Understand	1
17	Define Phase	Understand	1
18	Define Solid solution	Understand	1
19	Define Intermediate phase	Understand	1
20	Define Electron compound	Understand	1
Part - B (Long Answer Questions)			
1	Define grain and grain boundary? What are the characteristics of grain boundary?	Understand	1
2	What is grain size? What are the methods for determining grain size?	Understand	1
3	Explain effect of grain size on properties	Understand	1
4	State and explain Humme Rothery rules for the formation of solid solutions	Understand	1
5	What are intermediate phases? What are the various types of intermediate phases?	Understand	1
6	What is a crystalline material? Distinguish between single crystal material and polycrystalline material?	Understand	1
7	Define the terms (i) Space lattice (ii) unit cell (iii) solid solution and monotectic solution	Understand	1
8	Explain the procedure to find out the miller indices with an example	Understand	1
9	Draw the miller indices for (i)(100) (ii)(110)(iii)(111)	Analyse	1
10	List out and draw various bravias lattice structures and their primitives	Analyse	1
11	Write the relation between a,b,c and α, β, γ in cubic crystal system, tetragonal crystal system, orthorhombic crystal system and Hexagonal crystal system	Analyse	1
12	Define packing factor? What is the packing factor for (i) Simple cubic crystal (ii)Body centred cubic crystal	Understand	1
13	What is effective number of atoms? Calculate the effective number of atoms in SC structure, FCC structure, BCC structure	Analyse	1
14	What is the relation between lattice constant (a) and atomic radius(r) in SC structure, FCC structure, BCC structure, HCP structure.	Analyse	1
15	Define coordination number. What is the coordination number for BCC,FCC,HCP,(Explain with proper procedure)	Understand	1
16	What is the necessity of alloying?	Remember	1
17	Write briefly about Humme Rothery rules.	Remember	1
18	What are solid solutions?	Remember	1
19	What are the types of solid solutions?	Remember	1
20	What is linear atomic density? Calculate the linear atomic density in [110] direction in the cooper crystal lattice in atoms per mm. copper is FCC and has a lattice constant of 0.351.	Analyse	1
Part - C (Problem Solving and Critical Thinking Questions)			
1	Compare cubic and body centred cubic crystal	Analyse	1
2	What is coordination number	Analyse	1
3	What is atomic packing factor	Analyse	1
4	Compare covalent and ionic bond	Analyse	1
5	What is metallic bond	Analyse	1

6	Compare coarse and fine grain structure	Analyse	1
7	Compare point and line defects	Analyse	1
8	Compare pure metals and alloys	Analyse	1
9	Compare substitutional and interstitial solid solutions	Analyse	1
10	What is melting range in alloys	Analyse	1
UNIT - II			
PHASE DIAGRAMS			
Part – A (Short Answer Questions)			
1	Define alloy	Understand	2
2	Define phase	Understand	2
3	Define Gibbs Rule	Understand	2
4	Define levers rule	Understand	2
5	Define coring	Understand	2
6	Define Isomorphous system	Understand	2
7	Define Eutectic system	Understand	2
8	Define Partial eutectic system	Understand	2
9	Define Peritectic system	Understand	2
10	Define Monotectic system	Understand	2
11	What is Critical Temperature?	Analyse	2
12	Define Phase Diagram	Understand	2
13	What are the types of substitutional solid solutions?	Analyse	2
14	What is Substitutional solid solution?	Analyse	2
15	Define cooling curve	Understand	2
16	Define S- N curve	Understand	2
17	What is Thermal Equilibrium Diagram?	Analyse	2
18	Draw the stages of structures from Solid to Liquid formation in binary system	Analyse	2
19	What are the intermediate phases?	Analyse	2
20	What is the use of Jominy and Quenching Machine	Analyse	2
Part - B (Long Answer Questions)			
1	Explain with the help of a diagram the cooling curve of pure metals	Understand	2
2	State and explain levers rule	Understand	2
3	Explain with the help of a diagram the cooling curve of alloys	Understand	2
4	State and explain Gibbs phase rule	Understand	2
5	Explain the unary phase diagram	Understand	2
6	Explain about non equilibrium cooling	Understand	2
7	Write in brief about the binary phase diagram	Understand	2
8	What is the purpose of phase diagrams?	Understand	2
9	Define the term isomorphism and polymorphism	Understand	2
10	Explain about the isomorphous system with a Ni-Cu diagram	Understand	2
11	Write a brief note about eutectic system	Understand	2

12	Explain the phase change in a eutectic system with an example	Understand	2
13	Write a short note on eutectoid system	Understand	2
14	Explain with an example the eutectoid system	Understand	2
15	What are dendrites?	Understand	2
16	Explain the formation of dendrites	Understand	2
17	What are the most common types of phase diagrams explain in brief	Understand	2
18	Draw and explain the Cd-Bi phase diagram	Analyse	2
19	Draw and explain the cooling curves for pure metals	Analyse	2
20	Explain about the levers rule and write its application	Understand	2

Part – C (Problem Solving and Critical Thinking)

1	Compare eutectic and peritectic reaction	Analyse	2
2	Compare eutectic and eutectoid reaction	Analyse	2
3	What is peritectoid reaction	Analyse	2
4	Compare peritectoid and eutectoid reaction	Analyse	2
5	What is a phase	Analyse	2
6	What is Gibbs phase rule	Analyse	2
7	Compare phase and component	Analyse	2
8	Compare isomorphous and eutectic system	Analyse	2
9	What is coring	Analyse	2
10	What are intermediate phases	Analyse	2

**UNIT-III
ENGINEERING MATERIALS-I**

Part - A (Short Answer Questions)

1	Define alloy	Understand	3
2	Define phase	Understand	3
3	Define Gibbs Rule	Understand	3
4	Define levers rule	Understand	3
5	Define coring	Understand	3
6	Define Isomorphous system	Understand	3
7	Define Eutectic system	Understand	3
8	Define Partial eutectic system	Understand	3
9	Define Peritectic system	Understand	3
10	Define Monotectic system	Understand	3
11	What is Critical Temperature?	Analyse	3
12	Define Phase Diagram	Understand	3
13	What are the types of substitutional solid solutions?	Analyse	3
14	What is Substitutional solid solution?	Analyse	3
15	Define cooling curve	Understand	3
16	Define continuous cooling transformation curves	Analyse	3
17	What is Thermal Equilibrium Diagram?	Analyse	3

18	Draw the stages of structures from Solid to Liquid formation in binary system	Analyse	3
19	What are the intermediate phases?	Analyse	3
20	What is the use of Jominy end Quenching Machine	Understand	3
Part – B (Long Answer Questions)			
1	Explain allotropic forms of iron and give lattice structure of each	Understand	3
2	Define ferrite, pearlite, austenite	Understand	3
3	What is peritectic reaction and explain with diagram	Understand	3
4	What is eutectic reaction in iron –carbide system and explain with neat diagram	Understand	3
5	Explain various phase reactions in iron-iron carbide system	Understand	3
6	Explain eutectoid reaction with neat sketch	Understand	3
7	Explain hyper eutectoid steels	Understand	3
8	Explain hypo euctoid steels	Understand	3
9	Explain effect of sulphur, phosphorous additions in steel	Understand	3
10	Explain isothermal transformation	Understand	3
11	Draw time temperature transformation curves and identify products	Understand	3
12	Draw continuous transformation curves and explain	Analyse	3
13	Explain annealing heat treatment	Understand	3
14	Explain normalizing	Understand	3
15	Explain hardening and tempering	Understand	3
16	Explain mar tempering	Understand	3
17	Explain hardenability and the method of testing using Jominy end quench	Understand	3
18	Classify stainless steels	Analyse	3
19	Explain properties and applications of austenitic stainless steels	Understand	3
20	Explain applications of Tool steels, HSLA steels and Maraging steels	Understand	3
Part – C (Problem Solving and Critical Thinking)			
1	What is allotropy in iron	Analyse	3
2	Compare ferrite and austenite	Analyse	3
3	Compare ferrite and pearlite	Analyse	3
4	Compare ferrite and cementite	Analyse	3
5	Compare hypo and hyper eutectoid steels	Analyse	3
6	Compare steels and cast irons as per carbon per percentage	Analyse	3
7	Compare low and medium carbon steels	Analyse	3
8	Compare annealing and hardening	Analyse	3
9	Compare annealing and normalizing	Analyse	3
10	Compare stainless steels and tool steels	Analyse	3
UNIT-IV ENGINEERING MATERIALS-II,III			
Part – A (Short Answer Questions)			
1	What are cast irons	Understand	4,5
2	What is gray cat iron	Understand	4,5

3	What is white cast iron	Understand	4,5
4	What is Malleable cast iron	Understand	4,5
5	What is spheroidal cast iron	Understand	4,5
6	How is carbon present in malleable cast iron	Analyse	4,5
7	How is carbon present in spheroidal cast iron	Analyse	4,5
8	How is carbon present in Gray cast iron	Analyse	4,5
9	What is microstructure of gray cast iron	Analyse	4,5
10	What is microstructure of white cast iron	Analyse	4,5
11	What is microstructure of spheroidal cast iron	Analyse	4,5
12	What is microstructure of malleable cast iron	Analyse	4,5
13	How are aluminium alloys classified	Analyse	4,5
14	What are heat treatable alloys	Analyse	4,5
15	What are non-heat treatable alloys	Analyse	4,5
16	What are the important copper alloys	Analyse	4,5
17	Classify Titanium alloys	Analyse	4,5
18	Where are titanium alloys used	Remember	4,5
19	What are the applications of copper alloys	Remember	4,5
20	What are the applications of aluminium alloys	Remember	4,5
Part – B (Long Answer Questions)			
1	Explain types of cast irons and give applications for each	Understand	4,5
2	What is the method of making white cast iron. Explain properties	Understand	4,5
3	What is gray cast iron and explain properties	Understand	4,5
4	What is malleable cast iron and explain properties	Understand	4,5
5	Why nodular cast iron is ductile. Explain properties	Understand	4,5
6	Discuss effect of Silicon, Manganese, Sulphur, Phosphorous in cast iron	Understand	4,5
7	Discuss Ni-resist and Ni-hard cast irons	Understand	4,5
8	Explain heat treatable aluminium alloys and give applications	Understand	4,5
9	Discuss non-heat treatable aluminium alloys and give applications	Understand	4,5
10	Explain different copper alloys and give applications for each	Understand	4,5
11	What are types of brasses and explain properties	Understand	4,5
12	Discuss precipitation hardening with an example	Remember	4,5
13	Explain various bronzes and their properties	Remember	4,5
14	Classify titanium alloys and give typical applications for each	Analyse	4,5
15	Why ti-6al-4v alloys are useful for aero space applications	Remember	4,5
16	What are soldering alloys. Give typical applications	Understand	4,5
17	Explain properties applications of alpha titanium alloys	Understand	4,5
18	Explain beta titanium alloys	Understand	4,5
19	Explain properties and applications of duraluminum	Understand	4,5
20	Compare naval brass and muntz metal	Analyse	4,5
Part – C (Problem Solving and Critical Thinking)			

1	Compare gray and white cast iron	Analyse	4
2	Compare malleable and nodular cast iron	Analyse	4
3	What factors control structure of cast iron	Analyse	4
4	What is dominant mechanical property of cast iron	Analyse	4
5	What are the effects of graphite flakes	Analyse	4
6	Why nodular cast iron is ductile	Analyse	4
7	What are the effects of adding Si, Mn, S, p	Analyse	4
8	Compare heat treatable and non-heat treatable aluminium alloys	Analyse	4
9	Compare pure titanium and Ti-6Al-4 V	Analyse	4
10	Compare brasses and bronzes	Analyse	4
UNIT-V			
ENGINEERING MATERIALS-IV			
Part - A (Short Answer Questions)			
1	Classify ceramics	Analyse	2,4,5
2	What are uses of alumina ceramics	Remember	2,4,5
3	What are the uses of Zirconia ceramics	Remember	2,4,5
4	What are the uses of Silicon nitride	Remember	2,4,5
5	Classify Glasses	Analyse	2,4,5
6	Define glass	Understand	2,4,5
7	What is glass transition temperature	Understand	2,4,5
8	What is borosilicate glass	Understand	2,4,5
9	Compare soft and hard glasses	Analyse	2,4,5
10	What is thermal shock	Analyse	2,4,5
11	Classify polymers	Analyse	2,4,5
12	What is polymerisation	Understand	2,4,5
13	What are thermo plastics	Understand	2,4,5
14	What are thermo setting plastics	Understand	2,4,5
15	What additives are used in polymers	Understand	2,4,5
16	What are FRP	Understand	2,4,5
17	Define composites	Understand	2,4,5
18	Classify composites	Analyse	2,4,5
19	What is matrix in composite	Understand	2,4,5
20	What is fibre in composites	Understand	2,4,5
Part - B (Long Answer Questions)			
1	Explain general properties of ceramic materials	Understand	2,4,5
2	Classify ceramics with examples and applications	Understand	2,4,5
3	Explain properties and applications of alumina ceramics	Understand	2,4,5
4	Discuss properties and applications of zirconia ceramics	Understand	2,4,5
5	Explain properties and applications of silicon carbide	Understand	2,4,5
6	Discuss properties and applications of silicon nitride	Understand	2,4,5
7	Explain properties and applications of tungsten carbide	Understand	2,4,5

8	Define glass and classify types of glasses and give applications	Understand	2,4,5
9	Explain glass transition temperature and its importance in manufacture	Understand	2,4,5
10	Compare properties of hard and soft glasses	Analyse	2,4,5
11	What is stabilization in zirconia ceramics	Understand	2,4,5
12	Explain brittleness in ceramic materials	Understand	2,4,5
13	Define polymers. Classify them and give typical applications	Understand	2,4,5
14	Discuss methods of polymerisation	Understand	2,4,5
15	What are thermo plastics. Explain properties	Understand	2,4,5
16	What are thermo setting plastics. Give their properties	Understand	2,4,5
17	Classify composites. Explain their properties	Analyse	2,4,5
18	Discuss fibre reinforced plastics and their uses	Understand	2,4,5
19	Give properties of metal matrix composites	Understand	2,4,5
20	Explain ceramic matrix composites and give their properties	Understand	2,4,5
Part – C (Problem Solving and Critical Thinking)			
1	Compare alumina ceramics and glasses.	Analyse	2,4,5
2	Compare CBN and silicon nitride.	Analyse	2,4,5
3	Compare Zirconia and alumina ceramics.	Analyse	2,4,5
4	Compare hard and soft glasses.	Analyse	2,4,5
5	What are the factors for thermal shock resistance?	Analyse	2,4,5
6	Compare metal matrix and ceramic matrix composites.	Analyse	2,4,5
7	Compare composites and polymers.	Analyse	2,4,5
8	Compare FRP and PVC.	Analyse	2,4,5
9	Compare polymer matrix and ceramic matrix composites.	Analyse	2,4,5
10	Compare tungsten carbide and silicon nitride.	Analyse	2,4,5

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