B.TECH/ME/5TH SEM/MECH 3103/2021 ENGINEERING MATERIALS (MECH 3103)

Time Allotted : 3 hrs

Full Marks: 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A (Multiple Choice Type Questions)

1.	Choos	e the correct altern	$10 \times 1 = 10$			
	(i)	The atomic diamete (a) a√2 /2	er of an FCC crystal (l (b) a√2/4	attice parameter "a") is (c) $a\sqrt{3/4}$	[CO1] (d) a/2.	
	(ii)	Gibbs phase rule fo (a) F+P = C+2 (c) F+P = C+1	r condensed state rea	action under constant p (b) F+C = P+2 (d) F+1 = C+P.	ressure is [CO2]	
	(iii)	Pearlite is a mixtur (a) ferrite	e of cementite and [C (b) austenite	03] (c) bainite	(d) martensite.	
	(iv)	The hardness of ma (a) Carbon content (c) Ni content	artensite in a steel is a	a function of [CO5] (b) cooling rate (d) nose locatio	n.	
	(v)	Atomic packing fac (a) 0.64	tor of a face centered (b) 0.54	cube is equal to [CO1] (c) 0.74	(d) 0.84.	
	(vi)	Cross-slip occurs in [CO2] (a) Edge dislocation (c) both edge and screw dislocation		(b) Screw dislo (d) None of the	cation above.	
	(vii)	The heat treatment (a) carburizing (c) normalizing	process used for sof	tening hardened steel is (b) tempering (d) annealing.	[CO5]	
	(viii)	Composite materials are classified based on: [C (a) Type of matrix (c) Both (a) and (b)		l on: [CO6] (b) Size-and-shaj (d) None	:06] (b) Size-and-shape of reinforcement (d) None	
	(ix)	Which of the follow (a) Low strength	ving is a property of c	eramics? [CO6] (b) Low melting	g point	

B.TECH/ME/5TH SEM/MECH 3103/2021

(c) Resistant to corrosion

(d) Bad insulation.

- (x) Deformation that occurs due to stress over a period of time is known as [CO4] (a) Wear resistance (b) Fatigue (d) Fracture.
 - (c) Creep

- Group B
- 2. How different types of primary bond in solids affect the material properties? (a) (CO1 [Apply/IOCQ])
 - Strontium (Sr) has an FCC crystal structure, an atomic radius of 0.215 nm, and (b) an atomic weight of 87.62 g/mol. Calculate the theoretical density for Sr. Is the actual density same as theoretical density? If not then why? (CO1 [Evaluate/HOCO])
 - (c) Describe the rules which predict a hierarchy of conditions which determine its existence for specific alloys. (CO2 [Evaluate /HOCQ])

6 + 3 + 3 = 12

- Explain with diagram different types of surface defects. 3. (a) (CO2 [Understand/LOCO]
 - Mention the differences between the slip and twinning mechanism for plastic (b) deformation of metals. (CO2 [Analyze/IOCO])

6 + 6 = 12

Group - C

4. (a) With reference to Iron-Iron Carbide phase diagram discuss on the following: (CO3[Understand/LOCQ]) (i) Austenite (ii) Alpha Ferrite (iii) Delta Ferrite (iv) Cementite (v) Pearlite

(vi) Ledeburite.

(b) What are the main characteristics of stainless steels? Name different types of stainless steels and their main application? (CO3 [Apply/IOCQ])

6 + 6 = 12

- 5. (a) Describe the transformation that occurs during equilibrium cooling of steel with 0.18 % C present from 1500°C to normal temperature. (CO3 [Apply/IOCQ])
 - Why non-ferrous metals are used in industry in spite of their higher cost in (b) comparison with ferrous metals? (CO3 [Analyze/IOCQ])
 - (c) Name any three non-ferrous alloys mentioning their compositions, properties and applications. (CO3 [Understand/LOCQ])

4 + 2 + 6 = 12

Group - D

In order to evaluate various mechanical properties, a steel specimen of 12.5 mm 6. (a) diameter and 62.5 mm gauge length was tested in a standard tension test. Following observations were made during the test: Yield load =40KN

B.TECH/ME/5TH SEM/MECH 3103/2021

Maximum load=71.5 KN Fracture load= 50.5 KN Gauge length of fracture= 79.5 mm Determine (i) Yield point stress (ii) ultimate tensile strength (iii) percentage of elongation (CO4[Evaluate/HOCQ])

(b) Differentiate between engineering stress-strain and true stress-strain. (CO4 [Analyze/IOCQ])

6 + 6 = 12

- 7. (a) Discuss how different annealing processes affect properties. (CO5 [Analyze/LOCQ])
 - (b) What is carburizing? Justify the necessity of hardening and tempering the component after carburizing? (CO5[Evaluate/HOCQ])

6 + 6 = 12

Group – E

- 8. (a) Define corrosion and explain the different mechanisms of corrosion. (CO6[Understand/LOCQ])
 - (b) What are ceramic materials? Justify the advantages of ceramic materials. (CO6[Evaluate/HOCQ])

6 + 6 = 12

- 9. (a) What are the general properties to be considered while polymeric materials are to be used? (CO6 [Apply/IOCQ])
 - (b) Determine the volume ratio of aluminium and boron in aluminium- boron composite which can have the same young's modulus equal to that of iron. The young's modulas of aluminium, iron and boron are 71, 210, 440 GN/m² respectively. (CO6 [Create/HOCQ])

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25%	37.5%	31.25%

Course Outcome (CO):

After the completion of the course students will be able to

CO 1Classify different materials like metals, polymers, ceramics, composites and advanced materials and analyze different crystal structure of materialsCO 2Identify different types of defects in the material structure and construct the phase diagram of a multi-phase system of alloy.CO 3Analyze the Iron–Iron Carbide equilibrium diagram and discuss the composition properties and applications of ferrous and ponferrous alloy		
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broperties and applications of ferrous and ponferrous allow		
properties and applications of ferrous and nonferrous alloy.		
Explain mechanical, thermal, electrical and magnetic properties of material and		
implement the concept in mechanical components design.		
CO 5 Explain different heat treatment processes for ferrous material.		

MECH 3103

B.TECH/ME/5TH SEM/MECH 3103/2021

CO 6 Discuss the properties, applications and making processes of different polymers, ceramics, composites and nanomaterials.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission link:
ME-A	https://classroom.google.com/c/Mzk4MTYwMzQ5Mzc4/a/NDU0OTExODg0OTkx/details
ME-B	https://classroom.google.com/c/NDA1MzEwMzMwOTEy/a/NDY0ODY4Mzc2ODQy/details