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Menoufiya University Faculty of Engineering *Dept. Production Engineering* Final Exam (2014-15) - 2nd Term Date: May 24, 2015	جامعة المنوفية	**Metallurgy and Engineering Materials** **Code: PRE** Time: 3 hrs. Total Marks: 90 Marks

Solve the following questions:

Question no. 1 (15 marks)

a) What type(s) of bonding would be expected for each of the following materials: Argon, Sodium Chloride, Aluminum Oxide, Aluminum, Diamond, and Magnesium?

b) Differentiate, shortly, between edge and screw dislocations?

c) Within a cubic unit cell, draw the following crystallographic planes and directions:

$(20\bar{1})$, $(\bar{1}2\bar{1})$, $(3\bar{1}2)$ and $[101]$, $[\bar{1}1\bar{1}]$, $[\bar{2}11]$

d) Find planner density expressions for BCC (111) and (110) planes in terms of atomic radius R and compute the planner density values for these planes for iron where, R=0.124 nm.

Question no. 2 (15 marks)

a) Calculate the atomic packing factor for the BCC and FCC crystal structures?

b) For the tensile deformation of a ductile cylindrical specimen, describe changes in specimen profile to the point of fracture.

c) Differentiate briefly between elastic and plastic deformations?

d) What are the types of fracture in engineering materials? Describe the mechanism of crack propagation for each.

Question no. 3 (15 marks)

a) What is the magnitude of the maximum stress that exists at the tip of an internal crack having a radius of curvature 2.5×10^{-4} mm of and a crack length 2.5×10^{-2} mm of when a tensile stress of 170 MPa is applied?

b) Define fatigue and specify the conditions under which it occurs.

c) List four measures that may be taken to increase the resistance to fatigue of a metal alloy.

d) Define creep, show the creep curve and specify when it becomes important.

Question no. 4 **(15 marks)**

a) Explain the followings: (10P.)

- Joming test
- Stress corrosion cracking
- Normalizing
- DBTT
- Cavitation damage
- Austempering
- Martensite transformation
- Glass strengthening
- Crevice corrosion
- Process anneal

b) calculate the composite modulus of polyester reinforced with 60% vol glass fibers under:

i- Isostress ii- Isostrain loading conditions

(Ep = 6.9 GPa, Eg = 72.4 GPa) (5P.)

Question no. 5 **(12 marks)**

A and B are two elements partially soluble in the solid state. An alloy 20% B starts its freezing at 900 °C by separating α. Another alloy 85% B starts its freezing at 800 °C by separating β. At 750 °C, the first alloy contains 2/3 of its wt. as solid solution (90% A), while the second alloy contains 2/3 of its wt. as a liquid phase (80% B). Assume no solubility at 0 °C.

1- Draw the phase diagram A-B. (7p.)

2- For the two alloys: 10% B and 7% B (5p.)

- Sketch their cooling curves and microstructures at 0 °C.
- Is it possible to heat treat any (or both) of the two alloys? If yes, describe the steps in details

Total:12

Question no. 6 **(18 marks)**

a) Describe the steps undertaken in materials selection process. (2P.)

b) Give an industrial application for each of the following materials: (4P.)

-Graphene - Magnesium - Zin -PTFE

- Nodular cast iron - Titanium - Aramid fiber

c) A 1.05%C steel is slowly cooled from 900 °C to a temperature just slightly below 723 °C.

i- Calculate wt.% proeutectoid Cementite.

ii- Calculate wt.% eutectoid Cementite and wt.% eutectoid ferrite. (6P.)

d) Describe a method used to obtain a hard surface for each of the following cases:

- A steel shaft (1.5% Cr, 1% Al) that works at temperature 350 ~ 500 °C,
- A gear (0.5% C) steel that should resist wear. (6P.)

GOOD LOOK

This exam measures the following ILOs									
Question Number	Q1,Q6-a	Q4,Q3-a,b,c	Q2, Q6-d	Q3-d, Q6-d	Q6	Q5	Q3-d, Q5-b	These skills are measured else where	
Skills	a3-1	a19-1	b3-1	b6-1	b13-1	c1-1	c17-1	d1-1	d9-1
Knowledge &Understanding			Intellectual Skills			Professional Skills		General skills	