Menofiya University Faculty of Engineering Tim Allowed: 3 hour Second Semester Examination, 2015-2016 Date of Exam: 8/ 6 /2016	جامعة المنوفية كلية الهندسة - شبين الكوم	1st year (Mechanical Power) Material Science Code: PRE 111 Total mark: 70 marks Production Eng. Dep.

Answer all the following questions

QUESTION NO. 1

(20 Mark)

A) A composite bar made of aluminum and steel is held between the supports as shown in Fig.1. The bars are stress free at a temperature of 37 °C. What will be the stress in two bars when the temperature is 70 °C, if (a) the supports are unyielding; and (b) the supports yield come nearer to each other by 0.10 mm? It can be assumed that the change of temperature is uniform all along the length of the bar. Take Es = 210 GPa ; Ea = 74 GPa ; $\alpha_s = 11.7 \times 10^{-6}$ / °C ; and $\alpha_a = 23.4 \times 10^{-6}$ / °C.

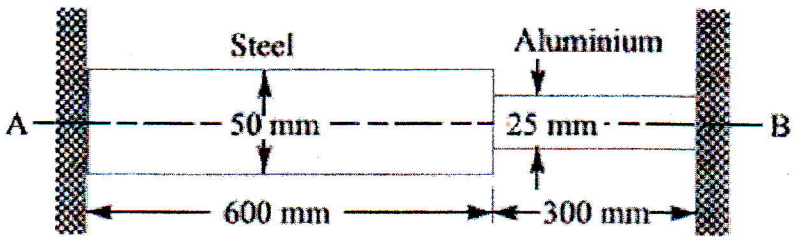


Fig (1)

B) A flat stainless steel 100 mm x 200 mm x 20 mm is compressed by forces in the plane of the plate so that the new lateral dimensions are 99.99 mm x 199.99 mm. assuming that the plate is free to expand in the thickness direction and that it is uniformly stressed. Take (E = 200 GPa and ν = 0.3).

Compute the change in thickness.

ı) If the plate thickness was constrained to remain constant, what stress would be applied in the thickness direction?

UESTION NO. 2

(15 Mark)

A) A solid steel shaft has transmitted 75 Kw at 200 rpm. Taking the allowable shear stress as 70 MN/m^2. Find the suitable diameter of the shaft, if the maximum torque transmitted on each revolution exceeds the mean by 30 %. Also find the angle of twist in a length of 2 metres. Take G = 84 GN/m^2.

B) A 250 mm (depth) x 150 mm (width) rectangular beam is subjected to maximum bending moment of 750 kN/m. Determine:

i) The maximum stress in the beam

ii) If the value of E for the beam material is 200 GN/m^2. Find out the radius of curvature for that portion of the beam where the bending is maximum.

QUESTION NO. 3

(17 Mark)

A) Discuss briefly with a flow chart the extraction process of iron from iron ore. Demonstrate the basic requirements of the material selection?

B) Draw the following planes in the case of a FCC structure: (213), (011) and (321). Determine APF of this structure.

C) For BCC iron, compute (a) the interplanar spacing and (b) the diffraction angle for the (220) set of planes. The lattice parameter for Fe is 0.2866 nm. Also, assume that monochromatic radiation having a wavelength of 0.1790 nm is used, and the order of reflection is 1.

D) Aluminum (melting point 660^0 C) and silicon (melting point 1420^0 C) are assumed to be completely soluble in the liquid state and completely insoluble in the solid state. They form a eutectic at 578^0 C, the eutectic composition being 13% silicon and 87% aluminum:-

1) Draw to scale the phase diagram of the alloy system Al-Si, labeling the lines, fields and points

2) For 7% Si :

i) Give the initial and final solidification and the freezing range.

ii) Describe the changes which take place during fall of temperature from the molten stage to room temperature.

3) When this alloy has cooled to temperature 20 ^{0}C below (i) what is the relative amount of solid/liquid phases.

QUESTION NO. 4

(18 Mark)

A) Differentiate between:-

- The Substitutional and interstitial
- The eutectic reaction and the eutectoid reaction

B) Write short notes about the followings:

- Annealing - Ledeburite - Quenching - Austenite - Martensite

C) Consider 1.5 kg of a 99.7% Fe and 0.3% C iron-carbon alloy that is cooled to a temperature below the eutectoid temperature.

i) Compute the amount of proeutectoid ferrite and pearlite that forms.

ii) Composition of Fe_3C and ferrite (α).

iii) Determine the amount of cementite that forms.

D) Determine the phase structure during the cooling of steel from TTT diagram, Fig. 2 in the following:

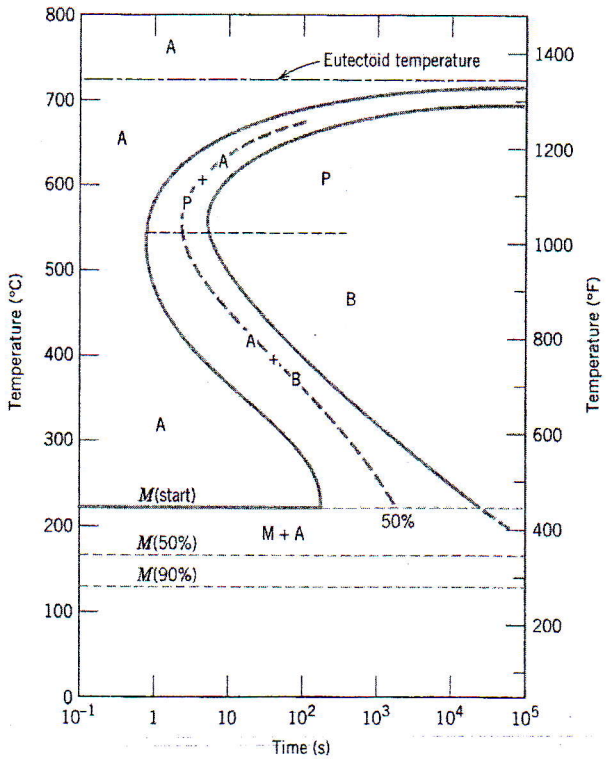
i) Rapidly cool to 350°C, hold for 150s, quench to T_{room}

ii) Rapidly cool to 400°C, hold for 500s, quench to T_{room}

iii) Rapidly cool to 650°C, hold for 25s, rapidly cool to 400°C, hold for 102s, quench to T_{room}

iv) Rapidly cool to 120°C, hold for 48s, quench to T_{room}

Fig (2)



******** GOOD LUCK**********

This exam measures the following ILOs															
Question number	Q1	Q2	Q3	Q4	Q4	Q1	Q2	Q3	Q4	Q4	Q1	Q2	Q3	Q4	Q4
skills	A1	A3	A3	A1	A2	B2	B2	B4	B2	B4	C1	C1	C3	C3	C3
	Knowledge & Understanding					Intellectual					Professional				

Prof. Dr / Soad Mohamed Serag & Dr. / Mahmoud Samir El-wazery