Menoufia University
Faculty of Engineering, Shebin El-kom
Production Engineering and Mechanical Design Department
Final term Exam, 2018-2019
Date of Exam: 3/ 6/ 2019

Subject: Materials Science
Code: PRE 129
Year: First (mechanical power)
2nd.semester
Time Allowed: 3 hours.
Total marks: 70 Marks

Notes: -Illustrating neat sketches are very important.
-Tables and charts are not allowed.

Answer the following questions

Question No. (1):- **(20Marks)**

a-Define the following items with the help of illustrating neat sketches and equations:

Proof stress-shear modulus-bulk modulus (6Marks)

b- State and explain clearly and briefly the sequential steps of recrystallization of metal with the help of neat sketches. (3Marks)

c-A test specimen was carried out on a tensile test specimen from steel with an initial cross section of 40 mm wide and 7 mm thick and an initial gauge length of 200 mm. The following test results were obtained the load (p) in kN and extension ΔL in mm

P, kN	20	40	60	80	100	87	100	120	125	90
ΔL, mm	0.07	0.14	0.21	0.28	0.49	3.7	5.1	9.6	28.4	50

i- Plot with a suitable scale the stress-strain ($\sigma - \varepsilon$) curve for this specimen. (4 marks)

ii- Determine the values of the following mechanical properties for this material:

Proportional limit stress, yield stress, ultimate tensile strength, modulus of elasticity, modulus of resilience, modulus of toughness and percentage elongation. (7 Marks)

Question No. (2):- **(20 Marks)**

a- Define the solid solution and explain its main types with the help of neat sketch. (5Marks)

b-Find the torsional strain energy U_T stored in a steel bar of diameter d=12 mm and length l=400 mm when it is twisted by a torque T=200 kg.cm and G=$8x10^5$ kg/cm^2. (6 Marks)

c- (9Marks)

Plot with a suitable scale iron –carbon phase diagram then if 0.55 % C hypoeutectoid plain carbon steel which is slowly cooled from 940°c to a temperature just below 723° c do the following:

i-Calculate the weight % proeutectoid ferrite present in the steel.

ii-Calculate the weight % eutectoid ferrite and the weight % eutectoid cementite present in the steel.

iii- Draw neat sketches of the cooling curve and microstructure for the 0.55 % hypoeutectoid plain carbon steel which is slowly cooled from 940°c to room temperature.

Question No. (3):- **(15 Marks)**

a-Derive in details and with neat sketch an expression giving the shear stress at radius r from the axis of circular shaft subjected to a twisting moment T, which produce an angle of twist θ in a length of L. **Then** derive the general formula of torsion for the circular shaft. (The modulus of rigidity for the material of the shaft is G). (7 Marks)

b-A metallic bar 35 x25 x10 cm is loaded as shown in figure 1. Find the change in volume take E=2100 ton /cm^2 and μ=0.28.Also find the change that should be made in the 600 tons load, in order that there should be no change in the volume of the bar. Also determine the values of shear modulus G and bulk modulus K for the bar material in Mpa. (8 Marks)

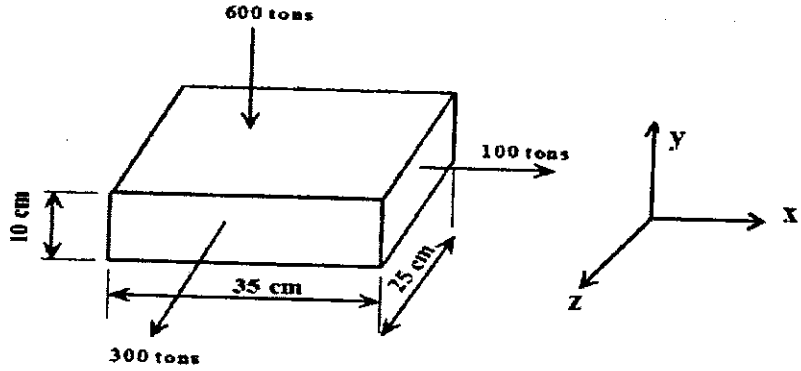

Figure 1

Question No. (4): **(15 Marks)**

a- Draw schematic phase diagram **(free hand sketch)** for a binary system of metals A and B which are soluble in the liquid state and completely insoluble in the solid state , (In your sketches label phase fields and give characteristic temperatures including melting temperature of each metal and thermal reaction present.) (6Marks)

b-If one kilogram of an alloy of 30% Ag is slowly cooled from 1000° c as shown in Ag-Cu phase diagram in figure 2, Calculate the following:

(i) The wt. % of the liquid and proeutectic α at 900°c. (3Marks)

(ii) The wt. % of the liquid and proeutectic α just above the eutectic temperature and the weight in kilograms of these phases. (3Marks)

(iii) The weight in kilograms of α and β formed by the eutectic reaction. (3Marks)

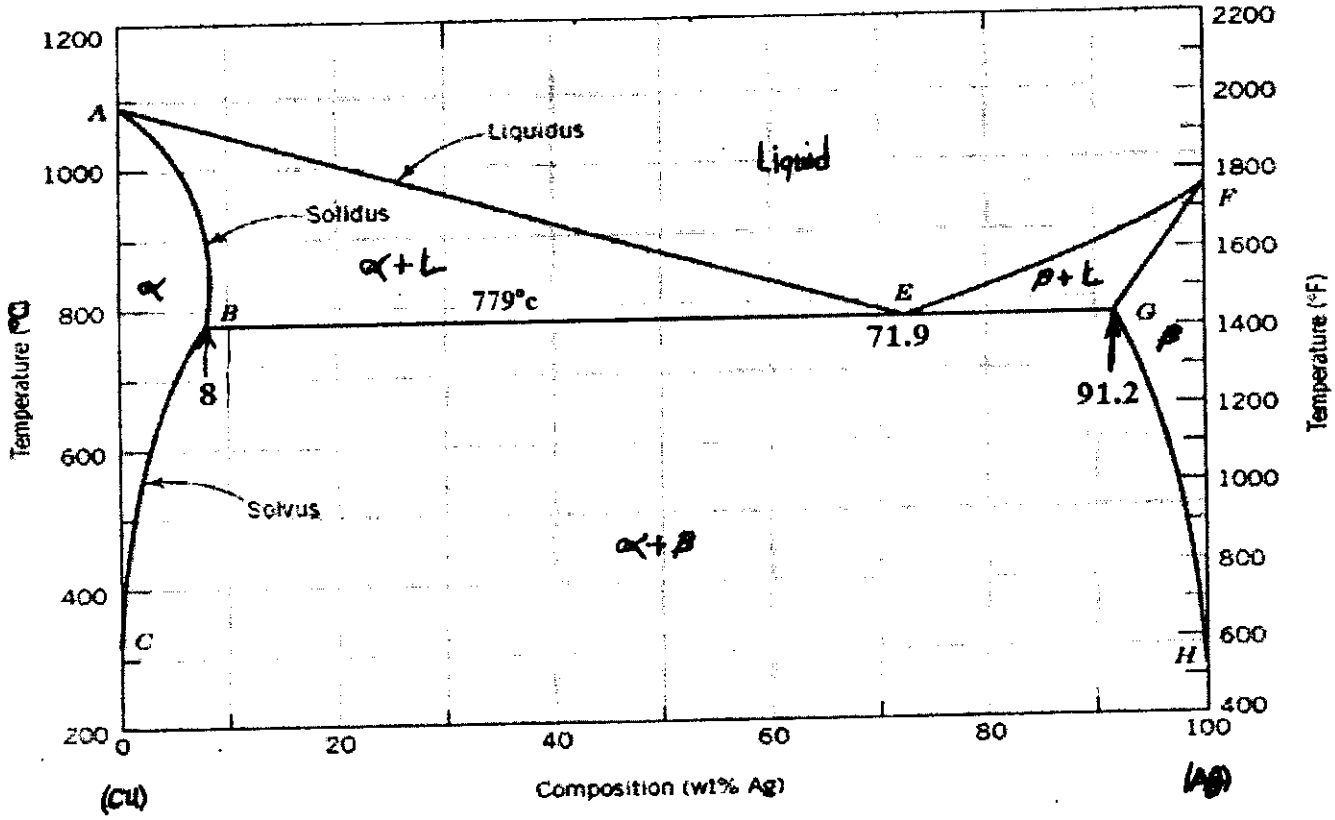

Figure 2

	This exam measures the following ILOs						
Question Number	Q1-a	Q1-b	Q1-c	Q2	Q3-a	Q3-b	Q4
Skills	A3	A8	A12	B2	B6	C5	C12
	Knowledge &Understanding Skills			Intellectual Skills		Professional Skills	

With our Best wishes,,,,,,,,,,,