



This exam. measures ILOs no. (a1, a3, a12, b2, b6, c5, c12, d3)  
Answer all the following Questions

Question (1)

(10 Mark)

A) Write short notes on:

Resilience, Hardness, Toughness, Modulus of elasticity, and Poisson's ratio.  
B) A load of 200 Kg is to be raised at the end of steel wire . If the stress in the wire must not exceed 800 Kg/cm<sup>2</sup>, what is the minimum diameter required? what will be the extension of a 3m length of the wire in this case ? Take  $E = 1 \times 10^6$  Kg/cm<sup>2</sup>

Question (2)

( 5 Mark)

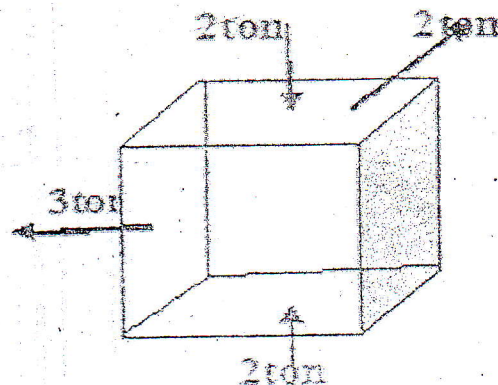
A hollow circular shaft of 20 mm thick transmits 294 KW at 200 r.p.m. Determine the diameter of the shaft if shear strain due to torsion isn't to exceed  $8.6 \times 10^{-4}$ . Take modulus of rigidity as 80 GN/m<sup>2</sup>.

Question (3)

( 5 Mark)

Steel cube block of 15 cm side subjected to 3 ton ( tension ), 2 ton ( compression ), and 2 ton ( tension ) along X, Y, Z directions respectively. Determine the change in volume .

Take  $E = 2 \times 10^6$ , and  $\mu = 0.25$



Question (4)

( 20 Mark)

- A) Write short notes about: Pearlite , Ledoburite  
B) Draw and label the iron (Fe) - carbon (C) equilibrium phase diagram showing the eutectic and eutectoid reactions on the diagram.  
C) Define the following phases present in the iron -carbon phase diagram:  
austenite, ferrite, cementite.  
D) Describe the full annealing heat treatment process of steel.  
E) For a 0.3% C steel slowly cooled from 950 °C to the room temperature determine:  
i ) the composition of phases present just above the eutectoid temperature room temperature.



ii) The weight percent of proeutectoid ferrite, eutectoid ferrite and cementite just below the eutectoid temperature.

iii) For this steel (0.3% C) draw a simple representation of the changes in microstructure during the slow cooling

Question (5)

(10 Mark)

Differentiate ( using simple sketches or equations ) between the following:

- Grey and spheroidal cast irons.
- Substitutional and interstitial solid solutions.
- Full annealing, normalizing and hardening of steel.
- Eutectic and eutectoid.

Question (6)

(20 Mark)

The slow cooling of number of bismuth (Bi) - antimony (Sb) alloys of different compositions gave the following results:

% Antimony	0	20	40	60	80	100
Temperature at which Solidification begins (°C)	271	400	490	550	600	631
Temperature at which Solidification ends (°C)	-----	285	320	370	550	-----

A) Using the above data draw and label the bismuth (Bi) - antimony (Sb) equilibrium phase diagram.

B) Draw the cooling curves for alloys containing 0%, 40% and 100% antimony.

C) Determine the composition and the weight percentage of the phases present in an alloy containing 40% antimony at 500 °C, 420 °C, 330 °C and at room temperature.

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Good Luck