Exam Date & Time: 23-Jan-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH MAKE UP EXAMINATIONS, JAN 2023

SCIENCE AND MECHANICS OF MATERIALS [MME 2159]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Answer the following and write relevant equations if any:

A) i. Write the difference between linear strain and lateral strain with relevant equations

ii. Define bulk modulus of a material

iii. Draw the comparative stress-strain diagram for toughness of ductile and brittle materials

iv. Define the term hardness (4)

B) Sketch neatly BCC and FCC unit cells and mention the coordination number and packing factor in both unit cells. (3)

C) With a neat sketch explain the concept of undercooling using actual cooling curve. (3)

2) Derive the equation for shear stress applicable for a beam. (3)

A)

B) A cylindrical shell is 3 m long, and is having 1 m internal diameter and 15 mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the shell, if it is subjected to an internal fluid pressure of 1.5 N/mm^2. (3)

C) With standard notations, Determine the packing factor of FCC unit cell. (4)

3) (4)

A) Melting temperatures of pure metals ‘A’ & ‘B’ are 1050^0C and 850^0C respectively. The metals ‘A’ and ‘B’ are mutually soluble in the liquid state and completely insoluble in the solid state. A liquid phase alloy containing 40% A completely transforms into a mixture of two solid solutions at 650^0C. Assuming the curves to be linear, draw phase diagram to scale and label the regions. For 30% B alloy determine the following:

(i)Weight percentage of eutectic formed at 400^0C.

(ii)The amount of liquid present and its composition, at a temperature of 800°C.

B) A steel plate of width 120 mm and of thickness 20 mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take E = 2 x 10^5 N/mm^2. (3)

C) An I section beam 350 mm x 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. If the shear force acting on the section is 40 kN, find the maximum shear stress developed in the I-section. (3)

4) Calculate and sketch the variation of shear force and bending moment for a simply supported beam which has a span of 9 m, is subjected to a UDL of 10 kN/m for 6 m starting from left support. (4)

A)

B) Write the three invariant reactions which can be found in the Iron – Iron carbide phase diagram. (3)

C) Differentiate between homogeneous & heterogeneous nucleation during solidification processes. (3)

5) Draw the neat sketch of the Iron-Carbide phase diagram and label all the salient points, lines and regions on it. (4)

A)

B) Derive the equation for maximum deflection of a simply supported beam of length L subjected to UVL throughout the span. Assume the load to vary linearly from zero at right end to maximum at the left end. (3)

C) A stepped cantilever shaft ABC is fixed at A. Portion AB has 1 m length and 80 mm diameter and is made of brass. Portion BC has 1.2 m length and 60 mm diameter and is made of steel. Calculate the maximum possible torque that can be applied in clockwise direction at C (viewing from free end C) and the angle of twist at C. Assume the permissible shear stress for brass and steel as 80 N/mm^2 and 100 N/mm^2 respectively. Take modulus of rigidity as 40 N/mm^2 and 80 N/mm^2 for brass and steel respectively. (3)

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