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20/12/2022 (19)
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Roll No. _____

National Institute of Technology Hamirpur (H.P.)

B.Tech. End-Semester Examination, December 2023

Branch : Engineering
Semester : 1st
Course Name : Basics of Mechanical Engineering

Course Code : ME-101
Time : 180 Mins
Max. Marks : 50

- Note:
1. Attempt all questions in an order. Marks for each question are indicated in the bracket.
 2. Attempt all parts of a question together. Assume suitable data if missing.

Q-1. A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested for tensile testing. It has an extension of 0.25 mm under a load of 80 kN, and the load at the elastic limit is 102 kN. The maximum load is 130 kN. The total extension at the fracture is 56 mm, and the diameter at the neck is 15 mm. Find the following: [4]

- (i) The stress at elastic limit.
- (ii) Young's modulus.
- (iii) Percentage elongation
- (iv) Percentage reduction in area.
- (v) Ultimate tensile stress

Q-2 (a) A solid circular shaft transmits 75 kW power at 200 rpm. Calculate the shaft diameter if the twist in the shaft is not to exceed 1° in 2 metres length of the shaft, and shear stress is limited to 50 MN/m^2 . Take Shear Modulus (G) = 100 GN/m^2 . [3]

(b) What are the assumptions associated with the derivation of the bending equation? Write the bending equation and mention its importance and use. [3]

Q-3. Analyze the simple truss shown in Figure 1 [4]

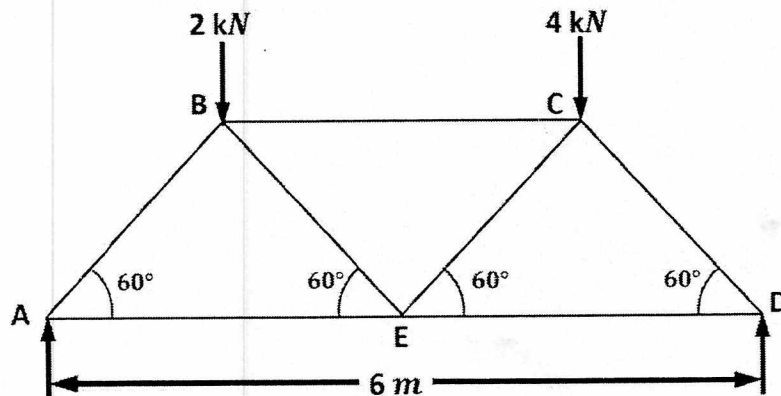


Figure 1.

- Q-4. (a) A semicircular area is removed from a trapezium, as shown in **Figure 2** (dimensions in mm). Determine the centroid of the remaining area. [4]

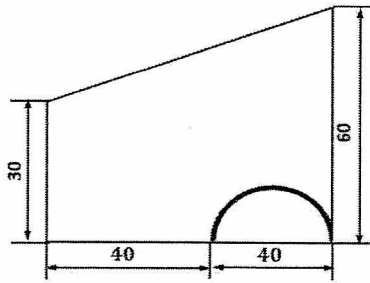


Figure 2.

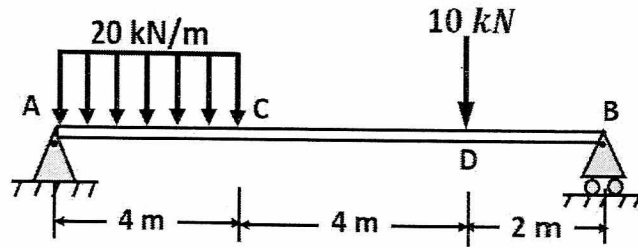


Figure 3.

- (b) A simply supported beam AB, 10 m long, is loaded as shown in **Figure 3**. Construct the shear force and bending moments diagrams for the beam. [4]
- Q-5. (a) Define the following terms: [4]
 (i) Pure substance (ii) Superheated Steam (iii) Sub-cooled liquid (iv) Dryness fraction
 (v) Latent heat of vaporization.
- (b) Derive the expression for the efficiency of the Diesel cycle along with the P-V plot. [4]
- Q-6. (a) Draw the Engineering Stress-Strain diagram for the Ductile and Brittle materials separately and mark the salient points in the graphs. Also, draw the Engineering and True Stress-Strain diagrams for a Ductile material on a single graph. [4]
- (b) Draw the temperature vs time graphs for the solidification of the casting of pure metals and alloys and mark the salient points. [4]
- Q-7. (a) With the help of schematic diagrams, explain what is barreling in forging operation. Write two significant reasons for barrel formation. [4]
- (b) Sketch three orthographic views of a single-point turning tool and indicate its different angles and nose radius. Write the tool signature in the standard format. [4]
- Q-8. With the help of a schematic diagram or flow chart, briefly explain the steps involved in a typical Additive Manufacturing process. Briefly explain the stair-step effect in Additive Manufacturing and how it can be minimized. [4]
