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

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH END SEMESTER MAKE-UP EXAMINATIONS, JANUARY 2023

STRENGTH OF MATERIALS [MME 2154]

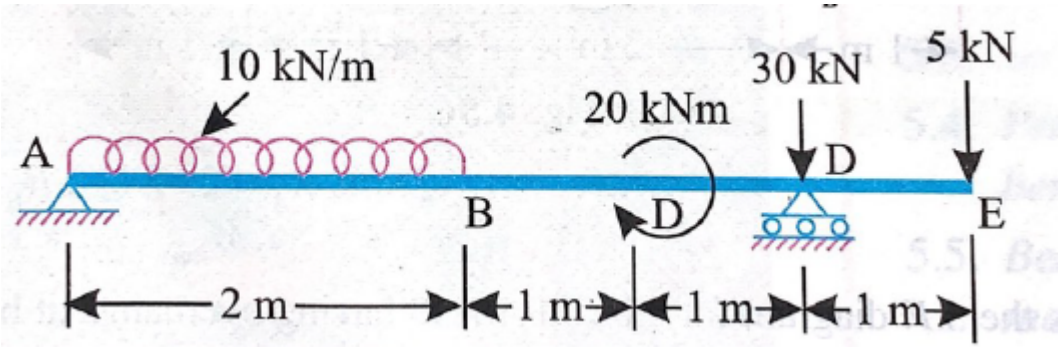
Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

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

1) Draw the shear force for the FBD shown below:

A) 

(4)

B) For the FDB shown in question 1A, draw the BMD. (3)

C) A thin cylindrical shell, 2 m long has 200 mm diameter, and the thickness of the metal as 10 mm. It is subjected to a fluid pressure of 5 MPa. What would be the circumferential stress and longitudinal stress induced in the shell? If the shell material has Young's modulus of 210 GPa and Poisson's ratio of 0.3, what would be the longitudinal strain induced in the shell? (3)

2) A) A hollow shaft 20 mm thickness transmits 300 kW at 200 rpm. Determine the diameter of the shaft if the shear stress in the shaft material is not to exceed 65 MPa. The modulus of rigidity of the shaft material is 80 GPa and the twist in a length of 3 m not to exceed 1.4 degrees. (4)

B) A 500 mm long bar has a rectangular cross-section of 20 mm X 40 mm. This bar is subjected to 40 kN tensile force on 20 mm X 40 mm faces, 200 kN compressive force on 20 mm X 500 mm faces, 300 kN tensile force on 40 mm X 500 mm faces. Find the volumetric strain, if the modulus of elasticity is 200 GPa and Poisson's ratio is 0.3. (3)

C) A 1.5 m long cast iron column has a circular cross-section of 50 mm diameter. One end of the column is fixed, while the other end is free. Taking a factor of safety as 3, calculate the safe load using Rankine's formula if crushing stress is 550 MPa and Rankine's constant is 1/1600. (3)

3) A beam of rectangular cross-section, 250 mm (depth) X 150 mm (width) and length 2m is simply supported and carries a uniformly varying load, which varies from zero at one (4)

A) end to 5 N/mm at the other end. Determine the maximum bending stress induced in the beam. What would be the radius of curvature of the beam for the above-mentioned case if the beam material has a modulus of elasticity of 200 GPa?

B) A hollow shaft 1 m long has an external diameter of 50 mm. It has 20 mm internal diameter for a part of the length and 30 mm internal diameter for the rest of the length. If the maximum shear stress in not to exceed 80 MPa, determine maximum power transmitted by the shaft at a speed of 300 rpm. If the twists produced in the two portions of the shafts are equal, find the length of the two portions. (4)

C) A steel flat of thickness 10 mm tapers uniformly from 60 mm at one end to 40 mm at the other end in a length of 600 mm. If the bar is subjected to a load of 60 kN, find its extension. The modulus of the elasticity of the bar material is 200 GPa. If the bar is untapered, what would be its extension? (2)

4) A simply supported beam of square cross-section with sides of the square measuring 250 mm is 8 m long. It carries concentrated loads of 50 kN each at a distance of 2.5 m from either supports. If the beam material has a young's modulus of 210 GPa, find the deflection at the loading points and slope at the supports. (5)

A)

B) Calculate the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to withstand an internal pressure of 25 MPa, if the permissible stress is limited to 125 MPa. (3)

C) A solid round bar 60 mm in diameter and 2.5 m long is used as a column. One end of the column is fixed, while its other end is hinged. Find the safe compressive load for this column using Euler's theory. Take the modulus of elasticity of the materials as 200 GPa and factor of safety as 3. (2)

5) A T shaped cross-section of a beam has top flange measuring 150 mm X 30 mm, overall depth of 150mm and thickness of the web 30 mm. If this section is subjected to a shear force of 5 kN, plot the variation of shear stress across the cross-section. (4)

A)

B) An element in a stressed material has tensile stress of 500 MPa and compressive stress of 350 MPa acting on two mutually perpendicular planes and shear stress of 100 MPa. Using analytical method, find the principal stresses and positions of the principal planes. Also, find the magnitude of maximum shear stress. (4)

C) A simply supported beam of span length 4 m is subjected to a uniformly varying load which varies from zero at one end to 10 N/mm at the other end. The cross-section of the beam is circular with a diameter of 120 mm. The beam has a Young's modulus of 200 GPa. Determine the maximum deflection and the slope at the supports (2)

-----End-----