Code No: 133BE **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, November/December - 2018
MECHANICS OF SOLIDS
(Common to ME, MCT, AE, MIE, MSNT)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART – A **(25 Marks)**

1.a) Define the principle of superposition. What is its utility? [2]
b) State Hooke's law. Sketch the stress-strain diagram for a ductile material like mild steel tested under tension upto destruction, marketing the salient points on it. [3]
c) Bring out the difference between statically determinate beam and statically indeterminate beam? [2]
d) What is the relation between shear force and loading, bending moment and shear force in a beam? [3]
e) Define moment of resistance of a beam? [2]
f) Sketch the bending stress as well as shear stress distribution for a beam of rectangular cross section. [3]
g) What do you mean by principal plane and principal stress? [2]
h) Define the term obliquity and how it is determined? [3]
i) Distinguish between thin cyclinder and thick cylinder and what are the applications? [2]
j) State the assumptions for shear stress in a circular shaft subjected to torsion. [3]

PART - B **(50 Marks)**

2.a) Derive an expression between modulus of elasticity and modulus of rigidity.
b) The extension in a rectangular steel bar of length 800 mm and of thickness 20 mm to be 0.25 mm. The bar tapers uniformly in width from 80 mm to 40 mm. If E for the bar is 2×10^5 N/mm^2, determine the axial tensile load on the bar. [5+5]

OR

3.a) What is the procedure of finding thermal stresses in a composite bar?
b) A bar of 15 mm diameter gets stretched by 4 mm under a steady load of 8000 N. What stress would be produced in the same bar by a weight of 800 N, which falls vertically through a distance of 10 cm on to a rigid collar attached at its end? The bar is initially unstressed. Take E = 2×10^5 N/mm^2 [5+5]

4. A beam of length 10 m is simply supported and carries point loads of 5 kN each at a distance of 3 m, and 7 m from left support and also a uniformly distributed load of 5 kN/m between the point loads. Draw the S.F and B.M diagrams for the beam. [10]

OR

5.a) What do you mean by point of contra flexure? Is the point of contra flexure and point of inflexion different?

b) A cantilever beam of 2 m long is loaded with a uniformly distributed load of 3 kN/m run over a length of 1 m from the free end. It also carries a point load of 5 kN at a distance of 1.5 m from the free end. Draw the S.F and B.M. [3+7]

6.a) What do you mean by simple bending? What are the assumptions made in the theory of simple bending?

b) Show from first principles that if a beam of rectangular section is subjected to a transverse shearing force, the maximum shear stress at a cross-section is 1.5 times the mean shear stress. [5+5]

OR

7.a) Prove that the relation between $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$.

b) An I-section beam consists of two flanges 160 mm × 25 mm and a web of 320 mm × 12 mm. Find the magnitude of maximum shear stress when it is subjected to a shear force of 60 kN. [5+5]

8.a) Explain with reasons which theory of failure is best suited for i) Ductile materials and ii) Brittle materials.

b) A point in a strained material is subjected to mutually perpendicular stresses of 40 N/mm^2 (tensile) and 20 N/mm^2 (compressive). It is also subjected to a shear stress of 20 N/mm^2. Draw Mohr's circle and find the principal stresses and maximum shear stress. [5+5]

OR

9.a) Derive an expression for the stresses on an oblique plane of a rectangular body, when the body is subjected to a simple shear stress.

b) Derive an expression for the distortion energy per unit volume when a body is subjected to principal stresses $\sigma_1, \sigma_2, \sigma_3$. [5+5]

10.a) A cylindrical shell is subjected to internal fluid pressure. Find an expression for change in diameter and change in length of the cylinder?

b) A hollow shaft has to transmit 337.5 kW at 100 rpm. If the shear stress is not to exceed 65 N/mm^2 and the internal diameter is 0.6 of the external diameter, find the external and internal diameters assuming that the maximum torque is 1.3 times mean. [5+5]

OR

11.a) Define the term polar modulus. Find the expression for polar modulus for a solid shaft and for a hollow shaft.

b) A spherical shell of 1.5 m diameter is subjected to an internal pressure of 1.45 N/mm^2. Taking the maximum allowable stress as 110 N/mm^2, find the necessary thickness of plate. Take the joint efficiency at 71%. [5+5]

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