9. Old Question Papers

R16

Code No: 133BE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, November/December - 2017 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)

a) Draw the stress-strain curve for mild steel and indicate salient points. [2]
b) What is lateral strain and poisson's ratio? [3]
c) Describe the concept of shear force in beams. [2]
d) Differentiate between varying loads and uniformly distributed loads. [3]

e) What assumptions are made in theory of simple bending? [2]
f) What are the advantages and applications of I-Section? [3]
g) What are the axial stresses and compound stresses? [2]
h) What is maximum principal stress theory? [3]
i) How the shaft is designed for maximum shear stress? [2]
j) What is hoop-stress and volumetric strain in shells? [3]

PART – B

(50 Marks)

2.a) How the temperature stresses are developed?

b) A steel bar is placed between two copper bars of same area and length at a temp of 15^0 C. At this stage, they are rigidly connected together at both ends. When the temperature is raised to 315^0 C, the length of bars increase by 1.6 mm. Find the original length and stresses in bars. Take E_s = 200 Gpa, E_c = 100 Gpa, α_s = 0.000012 per ^{0}C, α_e = 0.000018 per ^{0}C. [5+5]

OR

3.a) Derive equation for the relation between three elastic moduli.

b) A bar of 25 mm. diameter is subjected to a pull of 70 kN. The extension measured on a gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Find poisson's ratio and values of three moduli. [5+5]

4. A simply supported beam of span 10 m carry as UDL of 10 KN/m over a length of 3 m from left support and also from right support. Draw SF and BM diagram. [10]

OR

5. A beam of length 12 m has overhanging of 3 m on left and right leaving the span between the supports of 6 m. It carries UDL of 8 KN/m over the entire length and a concentrated load of 10 KN at the right extreme end. Draw SF and BM diagrams and find the point of contra flexure point. [10]

6.a) How to find neutral axis of a beam and explain its importance?

b) A cantilever beam of cross-section 90 mm. width 120 mm deep carries a UDL of 12 KN/m. over the entire length and a concentrated load of 15 KN at the right end. Find the bending stress in the beam, when the length of beam is 10 m. [5+5]

OR

7. A rolled steel Joist of I-Section has flange length of 300 mm. wide and 20 mm thick with a web thickness of 20 mm. and overall depth of I-Section is 600 mm. If this beam carries a UDL of 40 KN/m over the simply supported beam of span 10 m, find the maximum stress produced in the beam. [10]

8. At a point in a strained material, the intensities of normal stresses on two planes at right angles to each other are 35 N/mm^2 and 20 N/mm^2 both tensile. They are accompanied by shear stress of 15 N/mm^2. Find the principal planes and principal stresses. Find also maximum shear stress. [10]

OR

9. A circular shaft of 12 cm dia. is subjected to combined bending and twisting moments. The bending moment being three times the twisting moment. If the direct tensile yield point of material is 350 MN/m^2 and factor of safety on yield is 4, find the allowable twisting moment by a) Maximum principal stress theory b) Maximum shear stress theory.

[10]

10. A hollow shaft of 600 mm. external dia. and 400 mm internal dia. is transmitting a power of 6000 KW at 160 rpm. Find the shear stresses at the outer and inner surfaces of the shaft. Draw the shear stress distribution for the wall of the shaft. Find the twist over a length of 4 m. of the shaft. Take E = 80 Gpa. [10]

OR

11. A shell of 4 m. long, 1 m. diameter is subjected to an internal pressure of 1 N/mm^2. If the thickness of shell is 10 mm; find the circumferential and longitudinal stresses. Find also the maximum shear stress and changes in the dimensions of the shell. Take E = 200 Gpa. and poisson's ratio = 0.3. [10]

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PART – A (25 Marks)

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 steeltested 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 forcein 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 rectangularcross 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 of5 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 distanceof 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 shearstress. [5+5]

OR

9.a) Derive an expression for the stresses on an oblique plane of a rectangular body, whenthe 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]