(Following Paper ID and Roll No. to be filled in your Answer Book)

Paper ID : 100312 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. III) THEORY EXAMINATION, 2015-16

MECHANICS OF SOLIDS

[Time:3 hours] [Total Marks:100]

Attempt **all** the section.

SECTION–A

1. Attempt **all** parts. Write in brief: (2×10=20)

(a) Discuss the types of spring.

(b) Explain the generalized Hook'law.

(c) What are the limitations of Euler's formula?

(d) Define point of contra flexure and point of inflection.

(e) State first theorem of Castigliano.

(f) Define the term 'proof resilience'.

(g) Write down the Euler formula. What will be the effective length when both ends are fixed?

(h) Name any four theories of failure. Explain one of them.

(i) Write down the expression for Winkler Bach theory.

(j) Define method of singularity function.

SECTION–B

Attempt **any six** of the following: (5×6=30)

2. a) A cylindrical air drum is 2.25 m in diameter with plates 1.2 cm thick. The efficiencies of the longitudinal and circumferential joints are respectively 75% and 40%. If the tensile stress in the plating is to be limited to 120 MN/m². Find the maximum safe air pressure.

b) Generate a relationship between modulus of elasticity and bulk modulus.

c) At a point in a stressed body the princial stresses are 70MN/m² (tensile) and 40 MN/m² (compressive). Determine the normal stress and the shear stress on a plance inclined at 70 to the axis of major principal stress. Also calculate the maximum shear stress at the point.

d) The principal stresses at a point in a strained material are σ_x and σ_y. Show that the resultant stress σ_r on the plane carrying the maximum shear stress is given by:

$$\sigma_r = \left\{ \left(\sigma_x^{\,2} + \sigma_y^{\,2} \right) / 2 \right\}^{\frac{1}{2}}$$

e) A 3 m long cantilever carries a uniformly distributed load over the entire length. If the slope at free end is one degree, what is the deflection at the free end?

f) A simply supported beam of span 1 is carrying point load W at the mid span. Prove that the deflection at the center of the beam will be $\frac{1}{48EI} W1^3$

g) Define section modulus. Find the section modulus for hollow circular section having internal diameter d and external diameter D.

h) What is clapeyron's theorem? Derive and explain.

SECTION-C

Attempt **any two** parts of the following: (5×2=10)

a) Write down the assumptions of bending theory and drive the bending equation and section modulus of it.

b) A curved bar is formed of a tube of 120 mm outside diameter and 7.5 mm thickness. The center line of this beam is circular arc of redius 225 mm. A bending moment of 3kNm tending to increase curvature of the bar is applied. Calculate the maximum tensile and compressive stresses setup in the bar.

c) Define shear center. A channel section has flanges 12 cm ×2 cm and web 16 cm ×1 cm. Determine the shear center of the channel.

2. Attempt any one parts of the following: (5×2=10)

a) A helical spring made of 12 mm. diameter steel wire wound on a 120 mm diameter mandrel. If there achive coils, what is spring constant? Take C=82, GN/m^2. What force must be applied to the spring to elongate it by 40 mm?

b) Drive the expression, when a column at one side is fixed and other side free.

c) A solid round bar 50 mm in diameter and 2.5 m long is used as atrut. One end of the strut is fixed, while its other end is hinged. Find the crippling load and safe load using Euler's formula. Assume E=200 GN/m^2 and F.O.S −2.5.

3. Attempt **any two** parts of the following: (5×2=10)

a) Derive an expression for Lame's theory of thick cylinders.

b) A cylindrical vessel whose ends are closed by means of rigid flange plates is made of steel plate 2.5 mm thick. The internal length and diameter of vessel are 40 cm and 30 cm respectively. Determine the longtudinal and circumferential stresses in the cylinder shell due to an internal fluid pressure of 5 MN/m^2. Take E=200 GN/m^2 and 1/m=0.3.

c) Calculate the thickness of the metal required for a cast iron main 800 mm in diameter of water at a pressure head of 100 m, if the maximum permissible tensile stress is 20 MN/m^2 and. weight of water is 10 KN/m^3

4. Attempt **any one** parts of the following: (5×2=10)

a) Derive the expression of torsion equation for hollow circular shaft.

b) A simply supported beam with a span of 5 m carries a uniformly distributed load of 20 kN/m run. Find the slope at the ends and maximum deflection in the beam.

c) A beam of span L is fixed at bothe ends. it's is subjected to a couple M applied at the middle point of the beam about the horizontal axis normal to the beam. Show that the fixing couple at each support $\frac{M}{4}$ is in the same direction as M.

5. Attempt **any two** parts of the following: (5×2=10)

(a) Define the following:

(i) Shear strain

(ii) Bulk modulus

(iii) Mohr circle

b) A short metallic column of 500 mm^2 cross-sectional area carries an axial compressive load of 100 kN. For the plane inclined at 60. with the direction of the load, Calculate:

(i) Normal stress

(ii) Tangential stress

(iii) Max. shear stress.

c) A steel rod 12 m long is at a temperature of 18 °C. Find the free expansion of the length when the temperature is raised to 70 °C. Find the temperature stress produced when: (i) The expansion of the rod is prevented. (ii) The rod is permitted to expand by 5 mm. Take $\alpha = 12 \times 10^{-6}$ per °C, E=200GN/m^2.

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