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B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Third Semester

AERONAUTICAL ENGINEERING

U07AR302: Solid Mechanics

Time: Three Hours **Maximum Marks: 100**

Answer All questions:-

PART A (10 x 1 = 10 Marks)

1. Hooke's law is given by the relation

   (a) $\sigma = \varepsilon/E$ (b) $\sigma = E/\varepsilon$ (c) $\sigma = \varepsilon E$ (d) $\sigma = (E)^{\varepsilon}$

2. The ratio between lateral strain to linear strain is called

   (a) Poisson's ratio (b) volumentric strain (c) True strain (d) strain ratio

3. The relation between SF (V) and BM (M) is

   (a) V=dM/dx (b) M=dV/dx (c) $M=d^2V/d^2x$ (d) $V= d^2M/d^2x$

4. Bending stress (σ) may be represented by

   (a) Mz (b)M/z (c) z/M (d) all of these

5. According to double integration method moment (M)

   (a) EId^3y/dx^3 (b) EIdy/dx (c) EIy (d) none of these

6. Cantilever beam of length 'l' with a point load 'W' at free end, the deflection at the free end is

   (a) $Wl^2/2EI$ (b) $Wl^3/3EI$ (c) $Wl^2/3EI$ (d) $Wl^3/2EI$

7. Twist angle 'θ' in shaft can be calculated by

   (a) Tl/GJ (b) TG/lJ (c) GJ/Tl (d) TJ/Gl

8. Power (P) transmitted by the shaft is

   (a) T/ω (b) $T\omega$ (c) T^{ω} (d) ω^T

9. In a thin cylindrical pressure vessel the ratio of hoop to longitudinal stress is

   (a) 4 (b)1/4 (c) 1/2 (d) 2

10. When a thin cylinder is wound with wire under tension the hoop stress in cylinder shall be -------- in nature.

    (a) Tensile (b) compressive (c) bending (d) Zero

PART B (10 x 2 = 20 Marks)

11. Define Young's Modulus.

12. Write the relationship between E, G and K.

13. Define neutral axis of a beam.

14. What is pure bending?

15. Draw the bending stress and shear stress distribution across the depth of the rectangular beam subjected to lateral load.
16. What is continuous beam?
17. Define torsional rigidity of a shaft.
18. What is resilience of a close coiled helical spring under axial load?
19. What is thin shell?
20. A cast iron pipe is 1.25m in diameter and required to withstand 100m head of water. Assuming limited tensile strength for the pipe material as 21MPa, determine the thickness of metal.

PART C (5 x 14 = 70 Marks)

21. (a) A tension bar is found to taper uniformly from (D-a) cm diameter to (D+a) cm. Prove that the error involved in using the mean diameter to calculate Young's modulus is $(10\ a/D)^2$ per cent.

(OR)

(b) A mild steel bar 25 mm diameter and 250 mm long is placed inside a brass tube, having an external diameter of 30 mm and internal diameter of 25mm. The combination is then subjected to an axial load of 45 kN. Find (a) the stress in tube and rod (b) the shortening of the rod.

22. (a) A beam of 10m length is simply supported at its ends. It carries a uniformly distributed load of 20 kN/m run over the length of left half of its span, together with concentrated load of 20, 40, and 20 kN situated at 1.5, 2.5 and 5 m respectively from right hand support. Draw SFD and BMD.

(OR)

(b) A beam AB supported at its ends has a span of 2 m and carries a uniformly distributed load of 200kN/ m over the entire span. The cross section of beam is a T-section , having flange width 125 mm, flange thickness 25 mm, web thickness 25 mm and overall depth 200 mm. Calculate the maximum shear stress in the beam. Also draw the shear stress distribution marking principal values.

23. (a) A beam AB simply supported at ends is 4 m long. It carries a uniformly distributed load of intensity 20 kN/m over a length of 2 m starting at a distance of 1 m from left end support together with a concentrated load 40 kN at a distance of 3 m from the left end support. Calculate the deflection at the centre, if E= 210 GPa, I= 9600 cm^4.

(OR)

(b) A beam of uniform section, 10 m long is supported at the ends. It carries point loads of 100 kN and 60 kN at distance of 2m and 5m respectively from the left end. Calculate the deflection under each load and maximum deflection. Take E= 200 x 10^6 kN/m^2 and I = 18 x 10^{-4} m^4.

24. (a) A solid shaft is to transmit 300 kW at 100 rpm. If the shear stress is not to exceed 80 MPa, find the diameter of the shaft. What per cent saving in weight would be obtained if this shaft were replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, material and maximum shear stress being the same?

(OR)

(b) A close coiled helical spring whose free length when not compressed is 15 cm, is required to absorb strain energy to 50 N-m when fully compressed with the coil in contact. The maximum shearing stress is limited to 140 MPa. Assuming a mean coil diameter of 10 cm, find the diameter of the steel wire required and the number of coils. G = 80 GPa.

25. (a) A thin cylinder having internal diameter of 30 cm and wall thickness 1 cm is required to withstand an internal pressure of 5 MPa. It is strengthened with a single layer of 2 mm wire closely wound over it. Find the initial tensile stress in the wire if the stress in cylinder is not to exceed 50 MPa. Also find the final stress in the wire. For wire E_w = 200 GPa. For cylinder E_c = 100 GPa and Poisson's ratio, ν = 0.3.

(OR)

(b) The state of stress at a point in a stressed material is given by σ_x = 20 MPa, σ_y =10 MPa, τ_{xy} = 25 MPa. Determine the direction and magnitude of the principal stress in the material. Also locate the planes of maximum shearing stress and calculate the normal and shearing stress on the planes.

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