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| G.R. No. | |
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DECEMBER 2021-ENDSEM EXAM
S. Y. B. TECH. (CIVIL) (SEMESTER - I)
COURSE NAME: MECHANICS OF SOLIDS-I
COURSE CODE: ES21202CV
(PATTERN 2020)

Time: [1Hour]

[Max. Marks: 30]

(*) Instructions to candidates:

- 1) Answer Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6.
- 2) Figures to the right indicate full marks.
- 3) Use of scientific calculator is allowed
- 4) Use suitable data where ever required

Q.1) a) Uni-axial stress σ_x acts on X plane. Find out the normal and shear stresses σ_θ and τ_θ respectively on a plane making an angle of θ (CW) with X –plane. [4 marks]

b) In a strained material, on mutually perpendicular planes, the shear stresses are 30 MPa and -30 MPa and direct stress is zero on X and Y planes respectively. Compute the principal stresses and maximum shear stress. [6 marks]

OR

Q.2) a) In a strained material, on mutually perpendicular planes, the direct and shear stresses are $(0, \tau)$ on X plane and $(0, -\tau)$ on Y plane. Derive the expression for the normal and shear stresses σ_θ and τ_θ respectively on a plane making an angle of θ (CCW) with X – plane. [4 marks]

b) In a strained material on mutually perpendicular planes, the shear stresses are 30 MPa and -30 MPa and the direct stresses are 30 MPa (tensile) and -30 MPa on X and Y planes respectively. Calculate the direct and shear stresses, on an element making an angle of 45° CCW to X plane. [6 marks]

Q.3) a) Compute the crippling load using Rankine's formula for a circular column with diameter 200 mm. $\sigma_c = 250$ MPa, $\alpha = 1/1400$, $E = 140$ GPa. The column is 2.5 m long with both ends hinged. [4 marks]

b) A short column with rectangular cross-section ($b=300$, $d=300$) supports a load of 400 kN with eccentricity about X axis +10mm. Work out the maximum eccentricity about Y axis so that there is no tension in the column. [6 marks]

OR

Q.4) a) Compute critical load for a column 3 m long both ends with rectangular cross-section ($b=30$, $d=30$). Young's Modulus for the column material $E = 80$ GPa. Use Euler's formula. [4 marks]

b) A hollow rcc chimney 8 m high has uniform circular cross-section with outer diameter 2.0 m and wall thickness 300 mm. It is subjected to wind pressure of 2.0 kN/m^2

on the side. Find out the maximum and minimum stresses at the base. Sp. Wt. of rcc
 $w_{\text{rcc}} = 25 \text{ kN/m}^3$. [6 marks]

Q.5) a) A hollow shaft of 40 mm OD and thickness 5 mm is 2 m long and has $G = 70 \text{ GPa}$. Find out the torque it can carry if permissible twist is 1° . [4 marks]

b) Find out the slope and deflection at the free end of a cantilever of span 'L' subjected to UDL 'w', by double integration method. Assume constant 'EI'. [6 marks]

OR

Q.6) a) Find out the slope at the support of a simply supported beam of span 'L' subjected to a point load 'P' at the midspan, by any method. Assume constant 'EI'. [4 marks]

b) A shaft of 3 m length is to be used to transmit power $P = 40 \text{ kW}$ at 200 rpm. If the maximum torque is likely to exceed the mean torque by 25%, Work out the required dimensions of hollow circular cross section for following condition: G is 110 GPa, permissible shear stress is 55 MPa. Assume $ID = 0.8 \text{ OD}$. [6 marks]