Duration: 3 Hours **Maximum Marks: 80**

Instructions : (1). Question No .1 is compulsory
(2) Answer any ***Three Questions*** from the remaining.
(3) Each full question carries **20** marks.
(4) Assume suitable data, if needed and state it clearly.

Attempt **any four**

Q.1 a) A boiler cylindrical shell is subjected to an internal steam pressure of 2 MPa. The thickness of shell is 16 mm and permissible stress is 110 MPa. Calculate the maximum diameter of the boiler, when the efficiencies of longitudinal and circumferential joints are 70 %& 30 % respectively. **05**

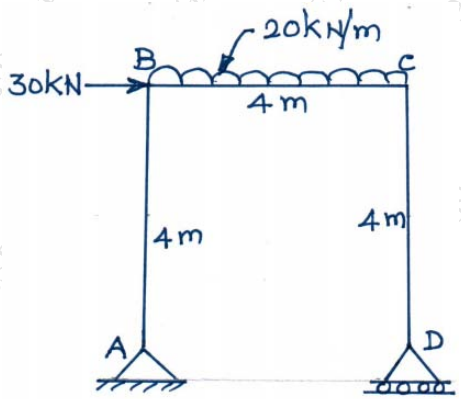
b) Enlists the relationship between rate of loading, shear force and bending moment and state their applications. **05**

c) What must be the length of 5 mm diameter aluminium wire, so that it can be twisted through one and half revolutions without exceeding a shearing stress of 50 MPa ? Take G = 27 GPa & J (I_p) = 61.3592 mm^4. **05**

d) Find the strain energy stored in a solid circular shaft of length 3m and diameter 600 mm, if maximum shear stress is 80 N/mm^2. Take G = 300 GPa. **05**

e) Explain 'Principle of virtual work' in brief. **05**

Q.2 a) A portal frame shown in figure. Draw SFD, & BMD for the column AB and beam BC only. **14**



b) A seamless spherical shell, 900 mm internal diameter, 10 mm thick. It is Being filled with a fluid under pressure until its volume increases by 160 cm^3. Determine the pressure exerted by the fluid on the shell. Take E = 200 GPa and μ = 0.3. **06**

Q.3 a) A solid circular shaft 200 mm in diameter is to be replaced by a hollow shaft, the ratio of internal diameter to external diameter as 3:5. Determine the diameters of hollow shaft, if maximum shear stress is to be the same as that of a solid shaft. **12**

b) Determine the strain energy of a simply supported beam of span 3 m having C/S 50 mm wide x 100 mm deep and subjected to a udl of 2 kN/m over its entire span. Take E = 200 GN/m^2. **08**

Q.4 a) The stresses at a point in a bar are 60 N/ mm^2 (tensile) and 40 N/mm^2 (compressive). Estimate normal, tangential and resultant stresses & its obliquity on an oblique plane making an angle of 70^0 with the plane of first principal stress. Use Mohr's Circle Method. **10**

b) A bar 12 mm diameter gets stretched by 0.4 cm under a steady load of 10 kN. What stress would be produced in the same bar by a weight of 10 kN which falls freely vertically through a distance of 80 mm to a rigid collar attached at its end? Take E = 210 x 10^3 MPa. **10**

Q.5 a) A seamless cylindrical vessel 3 m long which is closed at the ends has an internal diameter of 1000 mm and a wall thickness of 12 mm. Calculate the hoop and longitudinal stresses induced and also determine changes in diameter and length of vessel, if it is subjected to an internal pressure of 1.2 MPa. Take E = 210 GPa and μ = 0.3. **10**

b) A hollow circular shaft is to transmit 500 kW at 110 rpm, the maximum torque being 30 % greater than the mean. If the shear stress is not to exceed 60 MPa and internal diameter is 0.6 times of external diameter, find external & internal diameters of the shaft. **10**

Q.6 a) At a point two mutually perpendicular direction the stresses are 80 N/mm^2 tensile and 40 N/mm^2 tensile. Each of above stress accompanied by a shear stress of 60 N/mm^2. Determine analytically resultant stress and its obliquity on an oblique plane inclined at an angle 70^0 with the axis of major tensile stress. **10**

b) Determine slope and deflection at the free end of a cantilever beam shown In figure. The c/s of beam is 300 mm x 400 mm and E = 12 GPa. Use Principle of Superposition. **10**