(03 HOURS) **TOTAL 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.

Q.1 Attempt any four

a A solid metal rod circular in section, tapers from 30 mm diameter to 15 mm diameter in a length of 300 mm. How much will this length increase under an axial pull of 20 kN, if E = 110 GPa. (05M)

b State the relationships between rate of loading, shear force and bending moment at a C/S of a beam and mention their applications. (05M)

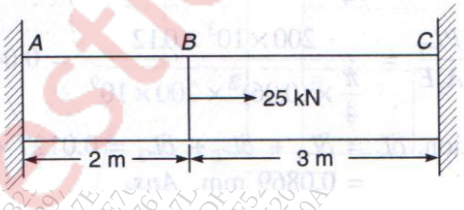
c A steel bar 32 mm in diameter is 3 m long. Find the work done when an axial pull of 80 kN is applied suddenly to it. Calculate the maximum instantaneous stress and elongation produced. Take E = 2×10^5 MPa. (05M)

d The angle of twist of a 5.5 m length of solid circular shaft whose diameter is 90 mm is observed to be 3.44^0 when the shaft is revolving 4 Hz. If G = 80 GPa, find the power transmitted by the shaft. (05M)

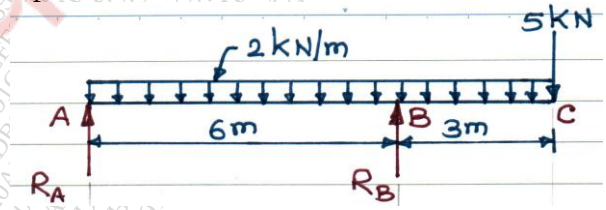
e Derive the 'Middle third rule' for a rectangular section in the case of no-tension condition. (05M)

f Enlist the assumptions made in the Euler's column theory. (05M)

Q.2 a) A prismatic bar as shown in figure, carries an axial load of 25 kN. Calculate the reactions at the supports assuming them rigid. (08M)



b) Draw the shear force and bending moment diagrams for the overhanging beam carrying loads as shown in figure. Marks the values of the principal ordinates and locate the point of contraflexure. (12M)



Q.3 a) A timber beam of rectangular section is simply supported at the ends and carries a point load at the centre of the beam. If the allowable design stresses are 12 N/mm^2 in bending and 1 N/mm^2 in shear, what will be the span to depth ratio so that the maximum bending and shear stresses occur simultaneously? (12M)

b) Derive the relationship between three elastic moduli (i.e. E,G and K) (08M)

Q.4 a) During tests on a sample of steel bar 25 mm in diameter, it is found that the pull of 50 kN produces an extension of 0.095 mm on a length of 200 mm and a torque 200 N-m produces an angular twist of 0.9^0 on a length of 250 mm. Find the Poisson's Ratio of the steel. (10M)

b) A timber joist of 125 mm width and 250 mm depth is used as a cantilever beam of 3 m length and loaded with a point load at its free end in addition to its self-weight, so that the bending stresses does not exceed 9 N/mm^2. Determine the maximum value of the applied load. Take unit weight of timber is 5000 N/m^3. (10M)

Q.5 a) The line of thrust, in a compression testing specimen 15 mm diameter, is parallel to the axis of specimen but is displaced from it. Calculate the distance of the line of thrust from the axis when the maximum stress is 20 % greater than the mean stress on a normal section. (10M)

b) The tensile and compressive stresses at a point across two mutually Perpendicular planes are 200 N/mm^2 and 100 N/mm^2. Determine graphically, the normal, shear (tangential) and resultant stresses on a inclined plane at 30^0 to the axis of minor stress by using Mohr's circle. (10M)

Q.6 a) A simply supported beam of length 4 m is subjected to a concentrated load of 60 kN at the mid span and deflects 15 mm at the centre. Determine the Euler's crippling load when the beam is used as a column with one end is fixed and other end hinged. Also, find the safe load taking FOS as 4. (10M)

b) A cylindrical shell is 3 m long, and is having 1 m internal diameter and 15 mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the shell, if it is subjected to an internal fluid pressure 1.5 N/mm^2. Take E = 2 x 105 N/mm^2 & μ = 0.3. (10M)