Submission Date:

ASSIGNMENT 3

1. *Analyze* and *explain* the failure stress of short, medium and long columns.

A long column has an I section with equal flanges of (180 mm x 14 mm) and web of (252 mm x 14 mm). When the column is used as simply supported beam with UDL of 30 kN/m, maximum deflection at midspan is 2 mm. *Analyze* the column for the safe load, it can carry (one end fixed and other free). Take FOS as 4 and E = 210 GPa.

2. A 2.5 m long column with hollow circular section is hinged at both the ends. External diameter is 140 mm and thickness of wall is 20 mm. Taking E = 80 x 10^9 N/m^2, a = 1/1600, σ_c= 550 MPa, *Analyze* and *compare* the buckling stress obtained using i) Euler's formula and ii) Rankine's formula.

3. *Analyze* and *explain* the failure of shaft under pure torsion (ductile material). A solid shaft 1.5 m long and 50 mm diameter is rigidly fixed at one end and subjected to a torque of 300 kN-m at the free end. If the total angle of twist is limited to 0.52º in full length, determine what length of 25 mm bore is to be drilled coaxially along the bar from the free end as shown in Figure 1. Take G = 0.82 x 10^5 N/mm^2.

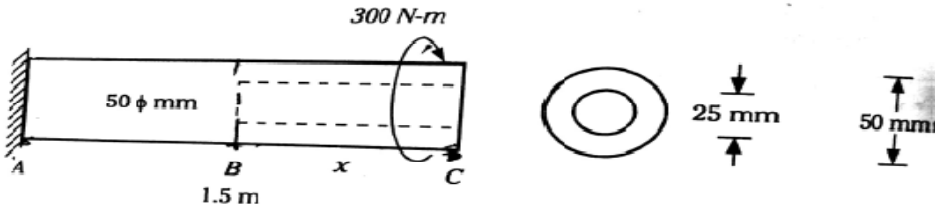

Figure 1

4. A flanged coupling is required for a shaft transmitting 220 kW at 240 rpm. The bolts are of 16 mm diameter and are to be arranged on a circle of 250 mm diameter. The working shear stress in the bolts must not exceed 60 MN/m^2. *Determine* the number of bolts required and the actual stress realized.

5. A square plate is subjected to biaxial stresses 120MPa (tension) and 80 MPa (comp). The plate is also subjected to a shear stress 60MPa such that shear force on vertical faces give rise to anticlockwise couple. *Determine* i) stresses on a plane whose normal is at an angle of 40º with reference to 120 MPa stress direction, ii) principal stresses and orientations of their planes, iii) maximum and minimum shear stresses and their planes, iv) a circle of diameter 200 mm drawn on the plate is converted into ellipse after the application of the stresses. Taking E = 200 GPa, 1/m = 0.3, determine the major and minor axes of ellipse.

6. A material is subjected to two mutually perpendicular linear strains together with a shear strain. One of the linear strain is 0.000025 (tensile). Using Mohr's circle, determine the magnitude of the other linear strain and the shear strain, if the principle strain are 0.00001 (compressive) and 0.00003 (tensile).