Code No: 154CA

**R18**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**B. Tech II Year II Semester Examinations, April/May - 2023**
**STRENGTH OF MATERIALS – II**
**(Civil Engineering)**

**Time: 3 Hours** **Max. Marks: 75**

**Note:** i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A**

**(25 Marks)**

1.a) Define the terms: Torsion, Torsional rigidity and Polar moment of Inertia. [2]
b) A closely coiled helical spring made of 16 mm diameter steel wire has 20 coils of 100 mm mean diameter. The spring is subjected to an axial load of 100 N. Determine the deflection. [3]
c) Define the terms buckling load and slenderness ratio. [2]
d) State the limitations of Euler's formula. [3]
e) How will you find the maximum and minimum stresses at the base of a symmetrical column, when it is subjected to load which is eccentric to both the axis? [2]
f) A short column of diameter 30cm carries and eccentric load of 60kN. Find the greatest eccentricity which the load can have without producing tension on the cross-section. [3]
g) What do you mean by Lame's equations? How will you derive these equations? [2]
h) A thin cylinder of internal diameter 3m contains a fluid at an internal pressure of $5N/mm^2$. Determine the thickness of the cylinder if (i) the longitudinal stress is not to exceed 40 $N/mm^2$. [3]
i) State the assumptions made in analyzing a beam for unsymmetrical bending. [2]
j) What is shear flow? Explain the general equations for shear flow. [3]

**PART – B**

**(50 Marks)**

2.a) A solid circular shaft transmits 75 kW power at 250 rpm. Calculate the shaft diameter (based on twist and shear stress), if the twist in the shaft is not to exceed $1^0$ in 2.5 m length of shaft, and shear stress is limited to 50 $N/mm^2$. Take C = 1 × 105 $N/mm^2$.
b) An open coiled helical spring has 12 turns. Assume the mean diameter of coil is eight times the diameter of the wire. An axial load is subjected, and then the maximum bending and shear stresses are 120 MPa and 130 MPa respectively. Find the diameter of the wire. Take E = 200 GPa and N = 85 GPa. [5+5]

**OR**

StudentSuvidha.com
downloaded from

Download all NOTES and PAPERS at StudentSuvidha.com

3.a) A hollow steel shaft 4 m long is to transmit 150 kW power at 150 rpm. The total angle of twist in this length is not to exceed 2.5 $^0$ and the allowable shear stress 60 N/mm $^2$. Determine the inside and outside diameters, if N = 0.082 × 106 N/mm $^2$. Take inside diameter is 0.5 times the outside diameter.

b) Two springs are connected in parallel. One has 16 coils of 6 mm diameter wire with an outside diameter of 36 mm and second has 18 coils of 4 mm diameter wire with an outside diameter of 40 mm. Find the maximum load that the system can carry without exceeding the shear stress of 350 MPa. Take G = 85 GPa. [5+5]

4.a) Calculate the safe compressive load on a hallow cast iron column with one end hinged and other end fixed of 25 cm external diameter and 20 cm internal diameter and 6 m in length. Use Euler's formula with factor of safety 3 and E = 100 GPa.

b) Derive an expression for the Euler's crippling load for a column with both ends hinged. [5+5]

**OR**

5.a) A simply supported beam of length 3 m is subjected to udl of 12 kN/m over the entire length and deflects 5 mm at the centre. Determine the crippling load when the beam is used as a column with one end fixed and other end hinged.

b) The external and internal diameters of a hollow cast iron column are 5 cm and 4 cm respectively. If the length of this column is 2 m and both of its ends are fixed. Determine the crippling load using Rankine's formula. Take the values of crushing stress as 550 N/mm$^2$ and $\alpha$ = 1/1600 in Rankine's formula. [5+5]

6.a) A column of rectangular section 120 mm × 90 mm carries a load of 60 kN at a point 30 mm from the longer side and 35 mm from the shorter side. Determine the maximum compressive and tensile stresses in the section.

b) A masonry retaining wall of trapezoidal section is 10 m high and retains earth which is level upto the top. The width of the top is 3 m and at the bottom is 8 m and the exposed face is vertical. Density of earth and masonry is 1500 kg/m$^3$ and 2200 kg/m$^3$ respectively and angle of repose is 30°. Find the maximum and minimum normal stresses at the base. [5+5]

**OR**

7.a) A column of rectangular section 200 mm × 300 mm carries a compressive load of 600 kN. The load is applied at a point (-50, 100) considering the centroid of the section as the origin. Find the stresses at the four corners of the section.

b) A steel column of length 5 m with both ends hinged, external diameter 180 mm and thickness 15 mm carries a load of an eccentricity 20 mm. Find the maximum value of load if the permissible stress is limited to 150 N/mm$^2$. Take E = 2 × 105 N/mm$^2$. [5+5]

8.a) A thin cylindrical shell of 150 cm diameter, 2 cm thick and 5 m long is subjected to internal fluid pressure of 2.5 N/mm2. If E = 200 GPa and Poisson's ratio is 0.25, find the change in length, change in diameter and change in volume.

b) A thick cylinder, of internal radius 50 mm and outside diameter 100 mm is subjected to an external pressure of 15 MPa and internal pressure of 50 MPa. Find the maximum hoop and radial stresses. [5+5]

**OR**

StudentSuvidha.com
downloaded from

Download all NOTES and PAPERS at StudentSuvidha.com

9.a) Derive an expression for hoop stress and longitudinal stress in a thin cylinder with ends closed by rigid flanges and subjected to an internal fluid pressure p. Take internal diameter and shell thickness of the cylinder is d and t respectively.

b) Find the thickness of metal required for a cylindrical shell of internal diameter 150 mm to withstand an internal pressure of 50 MPa. The maximum hoop stress is not to exceed 120 MPa. [5+5]

10.a) For an unequal angle of dimensions 100 mm × 50 mm × 8 mm thick, determine the position of principal axes and magnitude of principal moments of Inertia.

b) Determine the position of shear centre for a channel section of 140 mm × 140 mm outside and 10 mm thick. [5+5]

**OR**

11.a) A cantilever of length 1.2 m carries a point load of 2 kN at the free end and cross section is an unequal angle of dimensions 100 mm × 60 mm × 10 mm thick. Long leg is vertical and load passes through the centroid of cross section. Determine the position of neutral axis.

b) Find the position of shear centre of a channel having dimensions, flanges 140 mm × 25 mm and web 150 mm × 10 mm. [5+5]

**---ooOoo---**

downloaded from StudentSuvidha.com

Download all NOTES and PAPERS at StudentSuvidha.com