Code No: 134CD **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year II Semester Examinations, September/October - 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) Explain the difference between the behavior of closed coiled and open coiled springs. [2]
b) Write the assumptions made in deriving the torsion equation. [3]
c) Explain the assumptions made in Euler's column theory. [2]
d) Define the terms: column, strut and crippling load. [3]
e) Write briefly about Middle third rule for rectangular sections. [2]
f) A rectangular column of width 150 mm and thickness of 100 mm carries a point load of 140 kN at an eccentricity of 12 mm. What are the maximum and minimum stresses at the base of the column? [3]
g) Define thick cylinder. Write an expression for the radial pressure and hoop stress at any point in case of a thick cylinder. [2]
h) Write an expression for the change in volume, change in length and change in diameter of a thin cylindrical shell subjected to internal fluid pressure. [3]
i) Define and explain the term unsymmetrical bending. [2]
j) What is meant by shear centre? Explain the significance of the shear centre. [3]

PART – B

(50 Marks)

2.a) A hallow 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 = 0.082×10^6 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 the 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]

OR

3.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 = 1×10^5 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, 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]

4.a) A steel pipe of outside diameter 20 mm and thickness 3 mm is deflected by 3 mm when used as a beam supported at its ends, 1 m apart, and subjected to a central load of 150 N. Find the buckling load when the pipe is used as a column with hinged ends.

b) A strut 35 mm diameter and 3.2 m long is hinged at both the ends. It carries a point load of 120 kN at the center of the beam in addition to an axial thrust of 20 kN. Calculate the maximum stress. Take E = 200 GPa. [5+5]

OR

5.a) Compare the ratio of the strength of a hollow steel column to that of solid of the same cross-sectional areas. The internal diameter of the hollow column is ¾ of the external diameter. The columns have the same length and are pinned at the ends.

b) An equal angle of dimensions 100 mm × 100mm × 10 mm is used as a strut with a length of 3.5 m. The strut is hinged at both ends. Calculate the critical load by using Euler's formula. Take $E = 2 \times 10^5$ N/mm^2. [5+5]

6.a) A masonry retaining wall of trapezoidal section is 10 m high and retains earth which is level up to 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.

b) A hallow circular section of outside diameter 280 mm and thickness 10 mm carries a load of 1200 kN. Determine at what eccentricity along a diameter the load can be placed if the permissible stresses in compression and tension are 160 MPa and 70 MPa respectively. [5+5]

OR

7.a) A masonry dam of rectangular cross section 6 m high and 3 m wide has water upto the top on its one side. If the density of the masonry is 19.5 kN/m^3. Find the resultant force and the point at which it cuts the base of the dam.

b) 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. [5+5]

8.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) A closed thick cylinder has an internal diameter of 400 mm and an external diameter of 500 mm. It is 1.2 m long and is subjected to an internal pressure of 6 MPa. Determine the change in internal volume and thickness. Take E = 200 GPa and ν = 0.25. [5+5]

OR

9.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/mm^2. If E = 200 GPa and Poisson's ratio is 0.25, find the change in length, change in diameter, and change in volume.

b) Find the thickness of metal required for a cylindrical shell of internal diameter 120 mm to withstand an internal pressure of 40 MPa. The maximum hoop stress is not to exceed 130 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. The long leg is vertical and load passes through the centroid of cross section. Determine the position of neutral axis.

b) Determine the position of shear centre for a channel section of 150 mm × 150 mm outside and 8 mm thick. [5+5]

---ooOoo---