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**Presidency University**

**Bengaluru**

**SCHOOL OF ENGINEERING**

**Make**-**Up Examinations, July 2024**

**Semester**: 3

**Course Code**: CIV2007

**Course Name**: Strength of Materials

**Program:** B. Tech.

**Date**: 18/JULY/2024

**Time**: 09:30 AM – 12:30 PM

**Max Marks**: 100

**Weightage**: 50%

**Instructions:**

1. *Read the all questions carefully and answer accordingly.*
2. *Use of Non-programmable Scientific Calculator is permitted*
3. *Any missing data may be assumed suitably*

**Part A [Memory Recall Questions]**

**Answer all the Questions. (05Qx04M=20M)**

1. Determine the polar moment of Inertia (J) for a solid circular shaft of 300mm diameter. Also, determine the torsional moment or torque that the shaft is subjected to if it is transmitting a power of 120kW rotating at a speed of 200rpm. [04 M] (C.O.No.2) [Knowledge]

2. Bring out any four major differences between Short and Long Columns

[04 M] (C.O.No.3) [Knowledge]

3. Match the quantities with their appropriate units:

i. Stress a. mm

ii. Area b. No units

iii. Diameter c. MPa

iv. Poisson’s Ratio d. mm2 [04 M] (C.O.No.1) [Knowledge]

4. List out the assumptions made in Euler’s theory [04 M] (C.O.No.3) [Knowledge]

5. List out the assumptions made in deriving the Torsion equation [04 M] (C.O.No.2) [Knowledge]

**Part B [Thought Provoking Questions]**

**Answer all the Questions. (04Qx10M=40M)**

6. A hollow circular concrete column of 9m is to be used to support a pedestrian foot over bridge proposed across a major highway in Bangalore. The design is carried out by design consultancy firm appointed by the National Highway Authority of India (NHAI). Based on the design carried out with both ends hinged, the external diameter of the column is obtained to be 450mm and the ratio of internal to external diameter is 0.8. The design document is sent to you for third party verification to check load carrying capacity. Determine safe load that the column can carry if factor of safety (FoS) is 1.5 & Youngs Modulus is 0.25x105 N/mm2. [10 M] (C.O.No.3) [Comprehension]

7. TMT steel bar to be used for the construction of a residential apartment complex. A sample of this TMT steel bar is sent to our Basic Material Testing lab for testing. The steel sample of diameter 50mm and gauge length 350mm is tested in the Universal Testing Machine under uniaxial tension test. The results of the test are follows:

a. Load at Elastic Limit – 1500 kN

b. Deformation at 1000 kN load – 2mm

c. Change in diameter at 1000 kN load – 0.1mm

Based on the test conducted and the results listed above, list out the elastic constants of the material that can be determined. Also, estimate the values of these elastic constants for the given steel material. [10 M] (C.O.No.1) [Comprehension]

8. A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. Shafts have many uses in transportation, aerospace, automotive and industrial manufacturing industries. The torsional moment or torque applied to the shaft as a result of its rotation induces shear stress in the shaft. For good design of a shaft, the shear stresses induced are kept within the elastic limit. If you are asked to design a solid circular shaft made up of mild steel to transmit a power of 80kW at 120 rpm, what will be the diameter you would propose for the shaft if the shear stress for steel is not to exceed 75MPa and the torque transmitted by each revolution is expected to exceed the mean by 30%. Take C = 0.8 x 105 N/mm2.

[10 M] (C.O.No.2) [Comprehension]

9. Orientation of columns in any buildings is decided by architectural considerations (appearance) or structural considerations (efficient load transfer). From architectural considerations, the projection of columns outside the wall in a room should be avoided as they not only give bad appearance but also obstruct the use of floor space. With the above constraints, a rectangular column of 3.5m length and 230x450mm c/s is adopted for a commercial building. What would be the value of moment of inertia to be adopted for this column while determining the Euler’s crippling load? Based on Euler’s crippling theory, estimate the load that the column can carry if both of its ends are hinged. Compare and comment on the change in load carrying capacity if the ends of the column are fixed. Take E = 2x105 N/mm2.

[10 M] (C.O.No.2) [Comprehension]

**Part C [Problem Solving Questions]**

**Answer all the Questions. Each question carries 20 marks. (02Qx20M=40M)**

10. A 4m long column fixed at both ends has to carry a safe load of 2000kN. Determine the diameter required to be provided if a solid circular column is to be provided. If the solid circular column is to be replaced by a hollow column made up of same material, what will be the external and internal diameters that is required to be provided. Compare the area of solid and hollow column obtained and comment on which is more efficient. Take the ratio of internal to external diameter as 0.7, E = 2 x 105 N/mm2 and FoS = 1.5 [20M](C.O.No.3) [Comprehension]

11. A hollow circular shaft of 5m length has to transmit 65kW power at 150rpm. The internal diameter is 120mm and thickness is 20mm. The torque transmitted by each revolution exceeds the mean by 30%. Estimate the maximum intensity of shear stress induced and the angle of twist. Adopt C = 0.8x104 N/mm2. [20 M] (C.O.No.2) [Comprehension]