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**Presidency University**

**Bengaluru**

**SCHOOL OF ENGINEERING**

**Summer Term, August 2024 - END TERM EXAMINATION**

**Summer Term:** 2023-24

**Course Code**: CIV2007\_V02

**Course Name**: Strength of Materials

**Program & Sem**: B. Tech. & III Sem

**Date**: 05/Aug/2024

**Time**: 09:30 AM – 12:30 PM

**Max Marks**: 100

**Weightage**: 50%

**Instructions:**

1. *Read the all questions carefully and answer accordingly.*
2. *Do not write any matter on the question paper other than roll number.*
3. *Scientific and Non-programmable Calculators are permitted.*

**PART A**

**ANSWER ANY 4 QUESTIONS. (4Qx 5M= 20M)**

1. Define (i) Poisson's ratio and (ii) Modulus of Elasticity (iii) Stress (iv) Strain (v) Bulk Modulus

(C.O.No.1) [Knowledge]

2. Bring out the differences between short column and long column. (C.O.No.4) [Knowledge]

3. Calculate the intensity of stress and strain developed as well as the Modulus of Elasticity in a 2m long rectangular member of c/s 230mm x 450mm if it is subjected to a compressive load of 250kN and the deformation is 0.03mm.

(C.O.No.1) [Knowledge]

4. Sketch the shear force and bending moment diagram for a simply supported beam of span 3m subjected to a UDL of 5kN/m throughout its length.

(C.O.No.2) [Knowledge]

5. List the Assumptions made in Euler's Theory. (C.O.No.4) [Knowledge]

**Part B**

**ANSWER ANY 5 QUESTIONS. (5Qx10M=50M)**

6. A good structural design has to balance both safety and economy. If the Factor of safety for a brass bar is 2.5 and the ultimate stress that brass can develop is 400N/mm2, determine the safe working load that the brass bar of rectangular c/s 30mm x 50mm can carry. Also, find the deformation at the safe load if Youngs Modulus of brass is 0.97 x 105 N/mm2.

(C.O.No.1) [Comprehension]

7. 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.

(C.O.No.4) [Comprehension]

8. Calculate the maximum intensity of shear stress induced and the angle of twist for a solid shaft of length 10m & 100mm diameter. 112.5 kW power is transmitted at 150 rpm. Take G = 8.2x104 N/mm2.

(C.O.No.3) [Comprehension]

9. To determine the elastic properties and deformation characteristic of a material under uniaxial load, a specimen of the material is tested in the laboratory and the following data were obtained during a tensile test conducted on a Universal Testing Machine:

i) Diameter of the specimen = 27 mm ii) Length of specimen = 310 mm

iii) Extension under the load of 25 kN = 0.065 mm iv) Load at yield point = 120 kN

v) Length of the specimen after failure = 380 mm vi) Maximum load = 215 kN

vii) Neck diameter = 18 mm

Determine: i) Young’s modulus ii) Yield point stress

iii) Ultimate stress iv) Percentage elongation

(C.O.No.1) [Comprehension]

10. Sketch the Shear Force and Bending Moment diagram for the beam loaded as shown in Figure.

A diagram of a beam

Description automatically generated

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

11. 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 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.

(C.O.No.4) [Comprehension]

12. A mild steel circular bar has three segments as shown in Fig 7. Find

1. The total elongation of the bar
2. The length of the middle segment to have zero elongation of the bar.

The diameter of the last segment to have zero elongation of the bar. Take E = 205 GPa

A drawing of a house

Description automatically generated

(C.O.No.1) [Comprehension]

**Part C**

**ANSWER ANY 2 QUESTIONS. (2Qx15M=30M)**

13. A hollow shaft having an internal diameter 60% of its external diameter transmits 750kW at 250 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 50N/mm2 and the twist in a length of 2.5m should not exceed 1.4 degrees. Assume maximum torque = 1.20 mean torque and modulus of rigidity = 1.2 x 105 N/mm2.

(C.O.No.3) [Application]

14. Determine the diameter required to be provided for a solid circular column of 3m length to carry a safe load of 1200kN if the column is fixed at both ends. If the solid column is to be replaced by a hollow column made up of the same material, what will be the external and internal diameters of the hollow column that is required to be provided. Compare the area of solid and hollow column obtained and comment. Take internal to external diameter ratio as 0.6, Modulus of Elasticity, E = 2 x 105 N/mm2 and FoS = 1.5.

(C.O.No. 4) [Application]

15. A stepped compound bar made up of three different sections is subjected to forces as shown in Fig below. For the tapering portion the diameter at the smaller end is 12.5mm while it is 40mm at the bigger end. The principle of superposition is valid for the bar and the modulus of Elasticity for steel and aluminium is 200GPa and 70 GPa respectively. Compute the maximum intensity of P if total deformation of the bar is limited to 1mm.

Diagram of a diagram of a metal detector

Description automatically generated with medium confidence

(C.O.No.1) [Application]