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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKE-UP EXAMINATION JULY 2024

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| **Semester : III** | **Date : 02 July 2024** |
| **Course Code : CIV2007\_v02** | **Time : 09:30am to 12:30pm** |
| **Course Name : Strength of Materials** | **Max Marks : 100** |
| **Program : B. Tech. (Civil Engineering)** | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 4 QUESTIONS 4Q X 5M=20M** | | | |
| 1 | List out the assumptions made in Euler’s theory | (CO 4) | [Knowledge] |
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| 2 | Bring out any the differences between Short and Long Columns | (CO 4) | [Knowledge] |
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| 3 | Define: (i) Stress (ii) Strain (iii) Modulus of Elasticity (iv) Poisson’s Ratio  (v) Bulk Modulus | (CO1) | [Knowledge] |
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| 4 | Sketch the Shear Force Diagram and Bending moment diagram for a simply supported beam subjected to a uniformly distributed load throughout its length. | (CO2) | [Knowledge] |
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| 5 | Define Torsional Rigidity and Torsional Strength | (CO3) | [Knowledge] |
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| 6 | Determine the polar moment of Inertia (J) for a solid circular shaft of 200mm diameter. Also, determine the torsional moment or Torque that the shaft is subjected to if it is transmitting a power of 50kW rotating at a speed of 150rpm. | (CO3) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 7 | The load carrying capacity of columns is dependent on the effective length of columns which is turn influenced by the support conditions of the column at its ends. For a residential project based on architectural constraints, a long rectangular column of 3m length and 230x450mm c/s is adopted. What is the value of moment of inertia for the column to be adopted while determining the Euler’s crippling load? Determine the load that the column can carry if both of its ends are fixed adopting Euler’s Buckling theory. Compare and comment on the change in load carrying capacity if the ends of the column are hinged. Take E = 2x105 N/mm2. | (CO1) | [Knowledge] |
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| 8 | 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. | (CO4) | [Comprehension] |
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| 9 | 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 25mm and gauge length 450mm is tested in the Universal Testing Machine under uniaxial tension test. The results of the test are follows:  a. Load at Elastic Limit – 120 kN  b. Deformation at 75 kN load – 0.5mm  c. Change in diameter at 75kN load – 0.01mm  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. | (CO1) | [Comprehension] |
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| 10 | 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. | (CO 1) | [Comprehension] |
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| 11 | A hollow circular steel column of 7m length is to be used to support a pedestrian foot over bridge proposed across a major highway in Bangalore. The design is carried out by the design consultancy firm appointed by the National Highway Authority of India (NHAI). Based on the design carried out for the support condition of one end fixed and the other end hinged, the external diameter of the column is obtained to be 450mm and the ratio of internal to external diameter is 0.6. The design document is sent to you for third party verification to check the load carrying capacity. Determine the safe load that the column can carry if the factor of safety (FoS) is 2 and Youngs modulus of steel is 2.1x105 N/mm2. | (CO4) | [Comprehension] |
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| 12 | Sketch the Shear Force and Bending Moment diagram for the cantilever beam loaded as shown in Figure. | (CO2) | [Comprehension] |
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| 13 | 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 | (CO3) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 14 | A 4m long column fixed at both ends has to carry a safe load of 2500kN. 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 0.6, E = 2 x 105 N/mm2 and FoS = 1.5 | (CO4 | [Application] |
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| 15 | A hollow circular shaft of 5m length has to transmit 75kW power at 200rpm. The internal diameter is 125mm and thickness is 25mm. 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. | (CO3) | [Application] |
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| 16 | Sketch the Shear Force and Bending Moment diagram for the beam loaded as shown in Figure. | (CO2) | [Application] |
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