

Roll No.....

Total No. of Printed Pages: 2

Total No. of Questions: [09]

B. Tech. (Mech. Engg.) (Semester – 3rd)

STRENGTH OF MATERIALS-I

Subject Code: BMECS1301

Paper ID: [18112311]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(2 marks each)

Q1. Attempt the following:

- a) State Hooke's law.
- b) Explain the significance of modulus of rigidity.
- c) What is the ratio of the torques transmitted by a hollow and a solid shaft of the same material, length and weight?
- d) How is 'thermal stress' different from 'ordinary stress'?
- e) What do you mean by flitched beams? Show a flitched beam with a sketch.
- f) A beam of square section with side 'a' is used with its diagonal horizontal. Find the section modulus of the beam.
- g) What do you understand by '*point of contraflexure*'. Does it exist in a cantilever?
- h) Distinguish between slope and deflection of a beam.
- i) What are the different types of frames, and how do they differ in terms of their structural configurations and applications?
- j) Explain the assumptions made in determining the forces within a frame and the reactions at its supports.

Section – B

(5 marks each)

Q2. A simply supported beam of span 6 meter has a cross-section $100 \text{ mm} \times 250 \text{ mm}$. If the permissible stress is 8 MPa, find the maximum intensity of the uniformly distributed load it can carry. The maximum concentrated load W applied at 2 meters from one end it can carry.

Q3. A hollow steel shaft of 240 mm external diameter and 160 mm internal diameter is to be replaced by a solid alloy shaft. If both the shafts should have the same polar modulus, find the diameter of the later and the ratio of the tensional rigidities. Modulus of rigidity (C) for steel = $2.4 \times C$ for alloy steel. If alternatively, the two shafts should have the same torsional rigidity, find the ratio of their polar moduli.

- Q4.** A cantilever beam of length 3 m carries a uniformly distributed load over the entire length. If the slope at the free end is 0.0177 rad. Find the deflection at the free end.
- Q5.** Discuss the key differences between columns and struts, including their structural roles, typical end conditions, and how these factors influence their behavior under different loading conditions.
- Q6.** Derive Torsion Equation, write its applications and assumptions.

Section – C

(10 marks each)

- Q7.** What is Macaulay's method? Derive an expression for deflection at any section of a simply supported beam with eccentric point load, using Macaulay's method.
- Q8.** A simply supported beam of length 8 m rests on supports 6 m apart, the right-hand end is overhanging by 2 m. The beam carries a uniformly distributed load of 1500 N/m over the entire length. Draw S.F. and B.M. diagram and find the point of contra flexure, if any.
- Q9.** A point in a strained material is subjected to stresses shown in **Fig.** below. Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Check the answer analytically.

