

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov-Dec 2017

B. Tech Mechanical Engineering, Semester III

Roll No.....

ME306: STRENGTH OF MATERIALS

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

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- i. If a member is subjected to an axial tensile load, the plane inclined 45 degree to the axis of loading carries (a) minimum shear stress (b) maximum normal stress (c) maximum shear stress (d) none of the above
- ii. If a beam is supported on more than two support, it is called a (a) built in beam (b) continuous beam (c) simply supported beam (d) encastered beam
- iii. A fixed beam is a beam whose end supports are such that the end slopes (a) are maximum (b) are minimum (c) are zero (d) none of the above
- iv. The circumferential strain in case of thin cylinder shell, when subjected to internal pressure is (a) more than diametral strain (b) less than diametral strain (c) equal to diametral strain (d) none of the above
- v. The torque transmitted, by a solid shaft of diameter 40 mm if the shear stress is not to exceed 400 N/ cm², would be (a) $1.6 \times \pi$ N-m (b) $16 \times \pi$ N-m (c) $0.8 \times \pi$ N-m (d) $0.4 \times \pi$ N-m.
- vi. The equivalent length is equal to half of the actual length of column with (a) one end fixed and other is free (b) both ends fixed (c) one end fixed and other end hinged (d) both ends are hinged
- vii. Rankine's constant (α) for a given material of a column depends upon the (a) length of column (b) diameter of the column (c) length and diameter (d) none of the above
- viii. A loaded column fails due to (a) stress due to direct load (b) stress due to bending (c) both a, b (d) none the above
- ix. The principal stresses σ_1 , σ_2 , and σ_3 at a point respectively are 80 MPa, 30 MPa, and - 40 MPa. The maximum shear stress is (a) 25 MPa (b) 35 MPa (c) 55 MPa (d) 60 MPa
- x. With one fixed end and other free end, a column of length L buckles at load P_1 . Another column of same length and same cross-section fixed at both ends buckles at load P_2 . Then P_2/P_1 is (a) 1 (b) 2 (c) 4 (d) 16

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

Q.2A Define the terms Polar modulus. Find the expressions for polar modulus for a

solid shaft.

- Q.2B Define the terms: Principal planes and principal stresses. 05
- Q.2C What is equivalent length of a column? How is the concept used in the theory? 05
- Q.2D Explain the terms: hoop stress and longitudinal stress in thin cylinder. 05
- Q.3A Write a note on Mohr's circle of stresses. 05
- Q.3B Derive the expression for the stresses on an oblique plane of a rectangular body, when the body is subjected to a simple tensile stress. 05
- Q.4A Derive the expression for the slope and deflection of a beam subjected to uniform bending moment. 05
- Q.4B A beam 3 m long, simply supported at its ends, is carrying a point load W at the free centre. If the slope at the ends of the beam should not exceed 1 degree, find the deflection at the centre of the beam. 05
- Q.5A Show that in thin cylinder shells subjected to internal fluid pressure, the circumferential stress is twice the longitudinal stress. 05
- Q.5B A cylinder of internal diameter 2.5 m and of thickness 5 cm contains a gas. If the tensile stress in the material is not to exceed 80 N/mm^2 , determine the internal pressure of the gas. 05
- Q.6A A beam of length 5 m and of uniform rectangular section is supported at its ends and carries uniformly distributed load over the entire length. Calculate the depth of the section if the maximum permissible bending stress is 8 N/mm^2 and central deflection is not to exceed 10 mm. 10
- OR
- Q.6A A beam of length 5 m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9 kN/m run over the entire length. Calculate the width and depth of the beam if permissible stress is 7 N/mm^2 and central deflection is not exceed 1 cm. 10
- Q.7A Derive the relation for a circular shaft when subjected to torsion as given below 05
$$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$
 Where T = Torque transmitted, J = Polar moment of inertia, τ = max. shear stress, R = Radius of the shaft, C = Modulus of rigidity, θ = Angle of twist, and L = Length of the shaft.
- Q.7B A cylindrical pipe of diameter 1.5 m and thickness 1.5 cm is subjected to an internal fluid pressure of 1.2 N/mm^2 . Determine (i) longitudinal stress developed in the pipe (ii) Circumferential stress developed in the pipe. 05
- OR
- Q.7B A water main 80 cm diameter contains water at a pressure head of 100 m. If the weight density of water is 9810 N/m^3 , find the thickness of the metal required for the water main. Given the permissible stress as 20 N/mm^2 . 05
- Q.8A Derive the equation for the Euler's crippling load for a column with one end fixed and the other is free. 10

- Q.9A Explain the Rankine's formula and Justify that Rankine's formula is applicable for all lengths of columns. 10
- Q.9B A solid round bar 4 m long and 5 cm in diameter was found to extend 4.6 mm under a tensile load of 50 kN. This bar is used as a strut with both ends hinged. Determine the buckling load for the bar and also the safe load taking factor of safety as 4. 10

OR

- Q.9B Calculate the safe compressive load on a hollow cast iron column (one end rigidly fixed and other is hinged) of 15 cm external diameter, 10 cm internal diameter and 10 m in length. Use Euler's formula with a factor of safety of 5 and $E = 95 \text{ kN/mm}^2$ 10