NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA

THEORY EXAMINATION

Question Paper

Month and Year of Examination: December 2024

Programme: B.Tech | Semester: 3rd

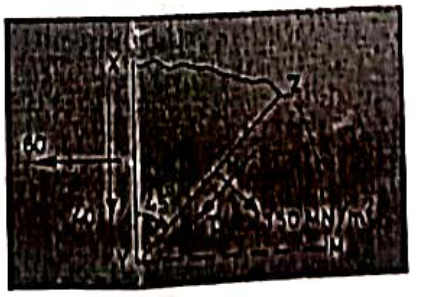
Subject: Strength of Materials - I | Course No.: MEPC203

Time Allotted: 3 Hrs. | Maximum Marks: 50

Assume suitably and state, additional data required, if any.

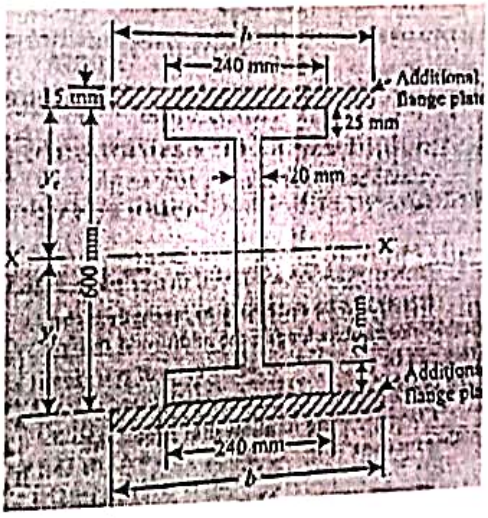
Attempt any five questions. Each question carries 10 marks.

1. A copper sleeve, 21 mm internal and 27 mm external diameter, surrounds a 20 mm steel bolt, one end of the sleeve being in contact with the shoulder of the bolt. After putting a rigid washer on the other end of the tube, a nut is screwed on the bolt until the compressive stress in the sleeve is 80 MN/m². Find the range of the external load that can be applied to this assembly if the stress in the bolt is never to be compressive and in the sleeve never to be zero. If instead of applying the external load to the bolt and tube assembly, the temperature is raised through 50°C, find the resultant stresses in the bolt and the tube. Take $E_s = 200$ GN/m² and $E_c = 90$ GN/m².
2. Passing through a point in a material, there are two planes XY and YZ. Plane YZ is inclined at 45° clockwise to XY. The direct and shear stresses on plane XY are 80 MN/m² tensile and 40 MN/m² respectively. On the plane YZ there is a tensile stress of magnitude 150 MN/m² and a shearing stress. Determine
   i. the magnitude of shearing stress on plane YZ
   ii. magnitude and direction of principal stresses
   iii. maximum and minimum shearing stresses and their directions



3. An overhanging beam ABCD, 18 m long, is simply supported at A and C 12 m apart. It carries a load of 15 kN concentrated at B which is at a distance of 4 m from A. In addition, there acts a distributed load with intensity varying from zero at A and D to 15 kN/m run at C. Draw the shear force and bending moment diagrams and calculate the position and magnitude of maximum bending moment. Also locate the points of contraflexure, if any.

4. An I section girder as shown in figure below simply supported over a span of 8 metres carries a uniformly distributed load of 100 kN/m over the entire span. The beam is strengthened by the addition of 15 mm thick flanges, wherever necessary. Determine the length and width of the flange plates such that maximum stress due to bending does not exceed 125 MN/m².



5. Explain the different theories of failure. Also explain the significance and graphical representation.

6. A horizontal beam of uniform section and length L rests on supports at its ends. It carries a uniformly distributed load of w per unit run for a distance 'a' from the right end. Using Macaulay's method calculate the value of 'a' for which the maximum deflection will occur at the left end of the uniformly distributed load.