Sub Code:EME302

Paper Id: 140309 Roll No:

B. TECH.
(SEM-III) THEORY EXAMINATION 2019-20
STRENGTH OF MATERIALS

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x10 = 20

a. Write down various assumptions made in simple bending theory.
b. What do you understand by product of inertia? Explain its importance in bending of a beam.
c. What do you understand by principal planes and principal axes?
d. What do you mean by the term "spring"? Explain various functions performed by a spring.
e. Explain why stresses induced in the body is more in case of impact load than gradually applied load.
f. Explain Hooke's law and differentiate between Young's modulus and modulus of rigidity.
g. Explain Castigliano's theorem and its importance.
h. What do you understand by theories of failures? Explain any one theory in brief.
i. What do you mean by Buckling Load in case of column?
j. What do understand by torsional rigidity and angle of twist?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Find reaction at supports of a continuous beam ABC when span length AB = 4 m and BC = 4 m. The span AB carries a point load of 20 kN at a distance of 1 m from support A and The span BC carries a uniformly distributed load having intensity of 8 kN/m.

b. An open coiled helical spring has 12 turns wound to a mean diameter of 100 mm. The angle of the coils with a plane perpendicular to the axis of the coil is 30^0. The wire diameter is 8 mm. Determine (i) The axial extension with a load of 80 N (ii) The angle turned by the free end if free to rotate. E = 205 MPa and G = 80 GPa.
c. A uniform T-section beam is 100 mm wide and 150 mm deep with a flange thickness of 25 mm and a web thickness of 12 mm. If the limiting bending stresses for the material of the beam are 80 MN/m^2 in compression and 160 MN/m^2 in tension, find the maximum u.d.l.that the beam can carry over a simply supported span of 5 m.
d. Prove that the maximum shear stress is 4/3 times of the average shear stress in beam of circular section subjected to a shear force
e. The span of simply supported and centrally loaded laminated steel spring is 650 mm. The central deflection of the spring does not exceed 40 mm for a proof load of 6 kN. The bending stress also does not exceed 360 MPa. Find the suitable values of width, thickness and the number of plates if they are available in multiples of 1mm for thickness and 5 mm for width. Also determine the radius to which the plates should be formed. Assume the width to be ten times the thickness E= 205 GPa.

SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10

(a) A steel rod 20 mm in diameter passes centrally through a steel tube of 25 mm

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internal diameter and 30 mm external diameter. The tube is 800 mm long and is closed by rigid washers of negligible thickness which are fastened by nuts threaded on the rod. The nuts are tightened until the compressive load on the tube is 20 kN. Calculate the stresses in the tube and the rod.

Find the increase in these stresses when one nut is tightened by one-quarter of a turn relative to the other. There are 4 threads per 10 mm. Take E = 2 X 10^5 N/mm^2

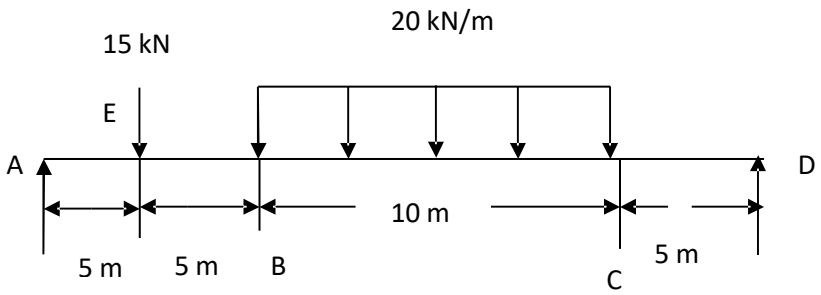
(b) An axial tensile load of 10 kN is applied to a 12 mm diameter bar. Determine the maximum shearing stress in the bar and the planes on which it acts. Find also the value of the normal stresses on these planes.

(c) **A** load of **2** kN falls through **25** mm on to a stop at the end of a vertical bar 4 m long, *600* mm^2 cross-sectional area and rigidly fixed at its other end. Determine the instantaneous stress and elongation of the bar.
E = 200 GN/m^2.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) Determine the deflection at point B and C of the beam shown in figure.

Take E = 200 GPa, I = 19802.8 cm^4



(b) A steel shaft is to be manufactured either as a solid circular bar or as a circular tube. The shaft is required to transmit a torque of 1200 N-m without exceeding neither an allowable shear stress of 40 MPa nor an allowable rate of twist of 0.75°/m. (The shear modulus of elasticity of the steel is 78 GPa.)
(a) Determine the required diameter of the solid shaft.
(b) Determine the required outer diameter of the hollow shaft if the thickness *of* the shaft is specified as one-tenth of the outer diameter.

5. Attempt any *two* parts of the following: 5 x 2 = 10

(a) A hollow circular section of steel, of outer diameter 200 mm and thickness 5 mm, has a length of 4 m, with both ends fixed. Find the Euler critical load if E = 200 GPa.If the yield stress is 300 MPa, determine the length below which Euler's formula cannot be applied.

(b) A short column of rectangular section 200 mm X 300 mm carries a compressive load of 800 kN. The load is applied at a point (-50,100) considering the centroid of the section as the origin. Find the stresses at the four corners of the section.

(c) A closed coil helical spring has mean diameter of 75 mm, spring constant of 80 kN/m and 8 coils. What is the suitable diameter of spring wire, if maximum shear stress is not to exceed 250 MN/m^2? Modulus of rigidity of spring wire material is 80 GN/m^2.What is the maximum load, the spring can carry?

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6. Attempt any *one* part of the following: 10 x 1 = 10

(a) A cylindrical boiler drum has hemispherical ends .The cylindrical portion is 1.6 m long, 800 mm diameter and 20 mm thick. After filling it with water at atmospheric pressure, it is put on a hydraulic test and the pressure is raised to 12 MPa. Find the additional volume of water required to be filled in the drum at this pressure. Assume the hoop strain at the junction of cylinder and the hemisphere to be the same for both. Take E = 205 GPa, K = 2080 MPa and Poisson's ratio= 0.3

(b) A thick steel cylinder has inner and outer diameters as 120 mm and 180 mm respectively. It is subjected to an external pressure of 9 MPa. Find the value of the internal pressure which can be applied if the maximum stress is not to exceed 30 MPa. Draw the curves showing the variation of hoop and radial stresses through the material of the cylinder.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) A curved bar of square section 75 mm X 75 mm and of mean radius of curvature 115 mm is initially unstressed .The bar is subjected to a bending moment of 7500 N-mm, which tend to straighten the bar. Find the stresses at the inner & outer faces. Also find the position of neutral axis.

(b) What do you understand by term shear centre? Derive the relation to find shear centre for channel section.

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