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B094312(037)

B. Tech. (Third Semester) Examination, Nov.-Dec. 2020

STRENGTH of MATERIALS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Part (a) of all questions are compulsory. Answer any two parts from (b), (c) and (d).*

Unit-I

1. (a) What do you mean by tensile, compressive and shear forces? Give examples. 2

   (b) Deduce an expression among three elastic constants of a material. 9

(c) Plot stress-strain diagram for mild steel. Explain its salient features. 9

(d) Two parallel walls 8 meters apart are to be stayed together by a steel rod of 30 mm diameter with the help of washers and nuts at the ends. The steel rod is passed through the metal plates and is heated. When its temperature is raised to 90°C, the nuts are tightened. Determine the pull in the bar when it is cooled to 24°C if :

(i) the ends do not yield

(ii) the total yielding at the ends is 2 mm

E = 205 GPa and co-efficient of thermal expansion of steel = 11×10^{-6} /°C. 9

Unit-II

2. (a) Define the term neutral axis and neutral surface. 2

(b) A hollow circular bar used as a beam has its outside diameter thrice the inside diameter. It is subjected to a maximum bending moment of 60 kNm. Determine the inside diameter of the beam if the permissible bending stress is limited to 120 MPa. 9

(c) Derive the relation between bending moment and shear force in a beam. What do you mean by points of contraflexure? 9

(d) A 10 m long simply supported beam carries two point loads of 10 kN and 6 kN at 2 m and 9 m respectively from the left end. It also has a uniformly distributed load of 4 kN/m run for the length between 4 m and 7 m from the left end. Draw the shear force and bending moment diagrams. 9

Unit-III

3. (a) Give the relation between slope deflection and radius of curvature. 2

(b) A simply supported beam of length l carries a concentrated load w at a distance a from left end A.

Determine :

(i) A relation for the elastic curve of the beam

(ii) Deflection at the midspan

(iii) Deflection under the load 9

(c) State and prove the moment area theorem. 9

(d) Determine the maximum bending moment and the deflection of *a b* simply supported beam of length *l* and flexural rigidity *EI*, carries a uniformly distributed load in the whole span of the beam. 9

Unit-IV

4. (a) How are the springs classified? Mention the use of each type. 2

(b) Deduce an expression for the axial deflection and axial rotation of an open-coiled helical spring under the action of a torque. 9

(c) A shaft transmits 280 kW of power at 160 rpm.

Determine :

(i) The diameter of a solid shaft to transmit the required power.

(ii) The inner and outer diameter of a hollow circular shaft if the ratio of the inner to the outer diameter. is 2/3.

(iii) The percentage saving in the material on using a hollow shaft instead of a solid shaft.

Take the allowable stress as 80 MPa and the density of the material 78 kN.m^3. 9

(d) 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°. The wire diameter is 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. 9

Unit-V

5. (a) Define principal stresses and principal strain in compound stress systems. 2

(b) Deduce expression for stresses on an inclined plane in a body subjected to a bi-axial stress condition. 9

(c) A piece of material is subjected to two perpendicular tensile stresses of 100 MPa and 60 MPa. Determine the plane on which the resultant stress has maximum obliquity with the normal stress. Also find the resultant stress on this plane. 9

(d) Obtain a relation for maximum principal stress and maximum shear stress for a shaft under the action of combined bending and torsion. 9