Registration No: | | | | | | | | | | |

Total Number of Pages: 03 **B.TECH**
PME3I101

3rd Semester Regular Examination 2016-17
MECHANICS OF SOLIDS
BRANCH: MECH
Time: 3 Hours
Max Marks: 100
Q.CODE: Y497

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 **Answer the following questions:** **(2 x 10)**

a) A steel bar of 40 mm × 40 mm square cross-section is subjected to an axial compressive load of 200 kN. If the length of the bar is 2 m and E = 200 GPa, the elongation of the bar will be _____.

b) A 100 mm × 5 mm × 5 mm steel bar free to expand is heated from 15°C to 40°C. It develops _____ stress.

c) Poisson's ratio is the ratio between _____ and _____

d) Section modulus is the ratio between _____ and _____

e) A concentrated load of P acts on a simply supported beam of span L at a distance *L/3* from the left support. The bending moment at the point of application of the load is _____

f) A simply supported beam of span length 6m and 75mm diameter carries a uniformly distributed load of 1.5 kN/m. The maximum value of bending moment is _____

g) The point of contraflexure is a point where_____ changes sign.

h) For a circular shaft of diameter d subjected to torque T, the maximum value of the shear stress is _____ .

i) The ratio of circumferential stress to longitudinal stress in a thin cylinder subjected to internal hydrostatic pressure is_____.

j) A closed-coil helical spring is subjected to a torque about its axis. The spring wire would experience _____ stress

Q2 **Answer the following questions:** **(2 x 10)**

a) Define Factor of safety

b) What is Complementary shear stresses

c) Explain about Pure Shear.

d) What are principal planes?

e) What is Mohr's stress circle ? Explain its significance.

f) Why wire winding of thin cylinders is required?

g) State the relation between shear force and bending moment.

h) What is a Strut ? How does it differ from a column ?

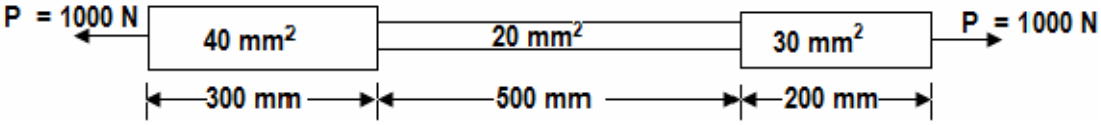
i) State the effective length of Euler's column for different boundary conditions

j) What is the value of shear stress at the centre of a circular shaft under

torsion?

Part – B (Answer any four questions)

Q3 **a)** A composite rod is 1000 mm long, its two ends are 40 mm^2 and 30 mm^2 in area and length are 300 mm and 200 mm respectively. The middle portion of the rod is 20 mm^2 in area and 500 mm long. If the rod is subjected to an axial tensile load of 1000 N, find its totalelongation. (E = 200 GPa). **(8)**

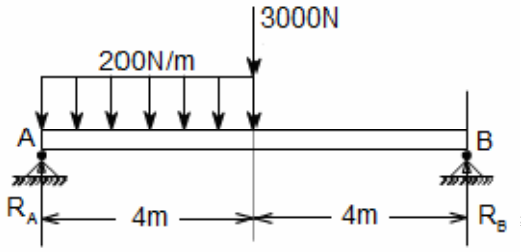


b) A cylindrical shell 3m long which is closed at its ends has an internal diameter of 1m and a wall thickness of 15mm. calculate the circumferential and longitudinal stresses induced and also change in dimensions of the shell if it is subjected to an internal pressure of 1.5 MN/m^2 **(7)**

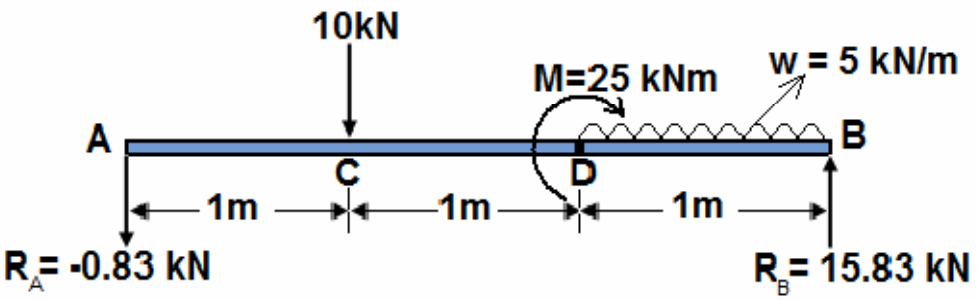
Q4 **a)** Direct tensile stresses of 120 MPa and 70 MPa act on a body on mutually perpendicular planes. What is the magnitude of shearing stress that can be applied so that the major principal stress at the point does not exceed 135 MPa? Determine the value of minor principal stress and the maximum shear stress. **(8)**

b) The principal tensile stresses at a point across two perpendicular planes are 100 MPa and 50 MPa. Find the normal and tangential stresses and the resultant stress and its obliquity on a plane at 200 with the major principal plane. **(7)**

Q5 A loaded beam is as shown below. Draw its S.F and B.M diagram. **(15)**



Q6 a simply supported beam AB (in figure below) of length 3m is subjected to a point load 10 kN, UDL = 5 kN/m and a bending moment M = 25 kNm. Find the deflection of the beam at point D if flexural rigidity (EI) = 50 KNm^2. **(15)**



Q7 **a)** Derive the relation $\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$, Symbols has their usual meaning. **(10)**

b) A Simply supported beam of span length 4 m supports a uniformly distributed load of intensity w = 4 kN/m spread over the entire span. The beam is constructed of a rectangular cross-section with width = 10 cm and the depth = 20 cm. Determine the maximum tensile and compressive stresses developed in the beam to bending. **(5)**

Q8 **a)** A solid shaft transmits 100 kW at 60 rpm. Determine the diameter of the shaft if the shear stress is not to exceed 75MPa. If the shaft is replaced by a hollow shaft whose internal diameter is 0.6 times external diameter, while length, material and the maximum shear stress are the same, find the percentage saving in weight. **(7)**

b) Two shafts are made of same material and transmit the same power. The first rotates at 50 rpm while the second rotates at 1000 rpm. Determine the ratio of diameters of the two shafts for the same maximum shear stress in each shaft. **(8)**

Q9 **a)** A close-coiled helical spring has coil diameter D, wire diameter d and number of turn n. The spring material has a shearing modulus G. Derive an expression for the stiffness k of the spring. **(8)**

b) A closed coil helical spring having 8 coils has a mean diameter of 75mm and spring constant of 80kN/m. Find the diameter of the spring wire if the maximum shear stress is not to exceed 260 MPa. Also calculate the maximum axial load that the spring can carry. Take G=80GPa. **(7)**