Total No. of Questions : 8]

SEAT No. :

PE-4350

[Total No. of Pages : 4

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S.E. (Automobile & Mechanical / Automation & Robotics / Mechanical Sandwich)

SOLID MECHANICS

(2019 Pattern) (Semester - III) (202041)

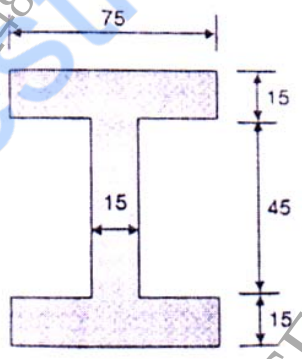
Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) ***Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.***
2) ***Figures to the right indicate full marks.***
3) ***Use Graph paper for Graphical solution.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume suitable data, if necessary.***

Q1) a) A beam of cross-section 100 mm × 200 mm is simply supported at both ends. It carries two concentrated loads of 100 KN each acting at 2m distance from each support. Span of beam is 7m. determine the maximum bending stress induced in the beam. **[9]**

b) Abeam of cross-section shown in Fig. is bent about a horizontal axis. If the bending moment is 8KN-m, determine the total force acting on the top flange. **[9]**

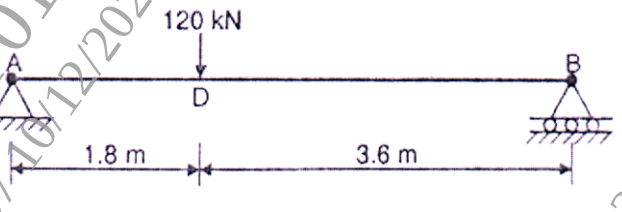


OR

P.T.O.

Q2) a) A symmetrical H-section with height 120 mm, width 120 mm and thickness 20 mm is used as a simply supported beam and carries UDL of 60 KN/m over a span of 3 m. Determine shear stress at neutral axis if inertia about neutral axis is 5.75×10^6 mm^4. **[9]**

b) The horizontal beam as shown in fig. is hinged at a point 'A' and supported on roller at point 'B'. It carries a vertical load of 120 KN at point 'D'. Determine deflection at point 'D' by taking E = 200 GPa and I = 160×10^6 mm^4. **[9]**



Q3) a) A hollow shaft with diameter ratio 3/5 is required to transmit 450 kW at 120 rpm with a uniform twisting moment. The shearing stress in the shaft must not exceed 60 N/mm^2 and the twist in a length of 2.5 m must not excced 1°. Calculate the external diameter of the shaft satisfying these conditions.Take the modulus of rigidity is 8×10^4 N/mm^2. **[9]**

b) A 4 m length of a tube has a buckling load of 2 kN when used as a column hinged at both ends. Calculate buckling load for 4.5 m length of the same tube when used as column if **[8]**

i) Both ends are fixed

ii) One end fixed and other is hinged

iii) One end is fixed and the other free

OR

Q4) a) A composite shaft consist of copper rod of 20 mm diameter enclosed in a steel tube of 60 mm external diameter and 20 mm thick. The shaft is required to transmit to torque of 1200 Nm. Determine the shear stresses developed in the copper and steel if both the shaft have equal length and welded to a plate at each end so that their twists are equal take modulus of rigidity for steel as twice that copper. **[9]**

b) Calculate the critical load for a strut which is made up of a bar circular in section, 1.2 m long and which is hinged at one end and fixed at the other end. The same bar when freely supported at its ends gives the central deflection of 3 mm, when a load of 100 N is placed at its centre. Also find the safe load taking factor of safety is 3. **[8]**

Q5) a) At a point in a strained material, the principal tensile stresses across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2. Determine normal stress, shear stress and resultant stress on a plane inclined at 20° with major principal plane. Determine also the obliquity. Use Mohr's circle method. **[9]**

b) A solid circular shaft is subjected to a bending moment of 45 kNm and a torque of 15 kNm. Design the diameter of the shaft according to : **[9]**

i) Maximum principal stress theory

ii) Maximum shear stress theory

iii) Maximum strain energy theory

Take μ = 0.25, Stress at elastic limit = 200 MPa and factor of safety is 2.

OR

Q6) a) A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and a tensile stress of 60 N/mm^2 on a plane at right angles, together with shear stresses of 70 N/mm^2 on the faces. Find the following terms : **[9]**

i) The magnitude of principal stresses

ii) The magnitude of greatest shear stress

iii) The location of principle plane

iv) The location of plane containing maximum shear stress

b) An axial pull of 25 kN along with a shear force of 20 kN is applied to a circular bar of 20 mm diameter. The elastic limit of the bar material is 250 MPa and Poisson's ratio, μ = 0.3. Determine the factor of safety against failure based on : **[9]**

i) Maximum shear stress theory

ii) Maximum strain energy therory

iii) Maximum principal strain energy theory

iv) Maximum shear strain energy theory