Total No. of Questions: 8]

SEAT No. :

PA-1277

[Total No. of Pages : 4

[5925]-302

S.E. (Automation&Robotics / Mechanical/ Automobile & Mechanical / Mechanical-S.W)

SOLID MECHANICS

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

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
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 hollow rectangular beam section square in size having outer dimensions 120 × 120 mm with uniform thickness of material 20 mm is carrying a shear force of 125 kN. Calculate the maximum shear stress induced in the section also draw the shear stress distribution diagram. **[9]**

b) A simply supported beam of span 8 m is subjected to point loads of 60 kN, 80 kN and 50kN at 2m, 4 m and 6 m from left support respectively. Determine slope at left support and deflection under 60 kN and 80 kN loads. Take EI= 2.668×10^9 kNm^2. **[9]**

OR

Q2) a) A T section of flange 180 mm × 30 mm and web 200 mm × 30 mm is simply supported at the both ends. It carries two concentrated loads of 110 kN each acting 2 m distance from each support. Span of the beam is 10m. Determine the maximum bending stress induced in the beam and draw bending stress distribution diagram and also find bending stress at the layer 110 mm from the bottom. **[9]**

b) A cantilever 2 m long carries a uniformly distributed load of 10kN/m over 1 m portion from fixed end and a point load of 20 kN at free end. Calculate the maximum slope and deflection of the cantilever. Take EI=2×10^3 kNm^2. **[9]**

P.T.O.

Q3) a) A steel shaft of 960 mm diameter is required to transmit 240 kW power at 240 r.p.m. and maximum torque is 40% greater than the mean torque.Find the maximum allowable stress in the shaft material. **[9]**

b) A hollow square section column is 4 m long (Outer dimension 150 mm × 150 mm and Inner dimension 100 mm × 100 mm). If it is fixed at its both ends, find the Euler's critical load on the column and corresponding stress. Take E = 180 Gpa **[8]**

OR

Q4) a) A hollow shaft transmits 100 kW at 120 r.p.m. Allowable shear stress in material is 50N/mm^2. Shaft shall not twist 2° in 1 m length. Ratio of internal diameter to external diameter is 0.25 Take G = 80 kN/mm^2. Maximum torque 15% more than mean torque. Calculate maximum external diameter of a shaft. **[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 if fixed and the other free.

Q5) 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) 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) At a point in a strained material, there are two mutually perpendicular stresses of 30 MPa and 70 MPa, both tensile. They are accompanied by a shear stress of 20 MPa. Determine principal plane and principal stresses. Use Mohr's stress circle method only. **[9]**

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 theory

iii) Maximum principal strain energy theory

iv) Maximum shear strain energy theory

Q7) a) Determine the stress resultant at four corners of column subjected to eccentric load of 500kN, as shown in Fig.1. **[8]**

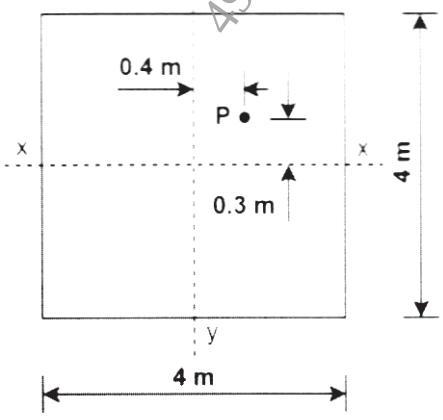

Fig. 1

b) A segment of a generator shaft is subjected to a torque T and an axial force P, as shown in the Fig.2. The hollow shaft having outer diameter d_2=280 mm and inner diameter d_1=230 mm and delivers 1800 kW at 4.0 Hz. If the compressive force, P=525 kN. What are the maximum tensile, compressive and shear stresses in the shaft? **[9]**

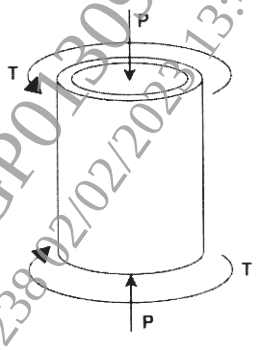

Fig. 2

OR

Q8) a) A hollow rectangular section is having external size 600 mm × 550 mm and internal size 500 mm × 450 mm. It carries a vertical load of 110 kN at the outer edge of the column on X-axis. Calculate maximum and minimum intensities of stress in the section. Assume 600 mm side horizontal. **[8]**

b) Determine the Principal stress in the beam at point A as shown in Fig.3. **[9]**

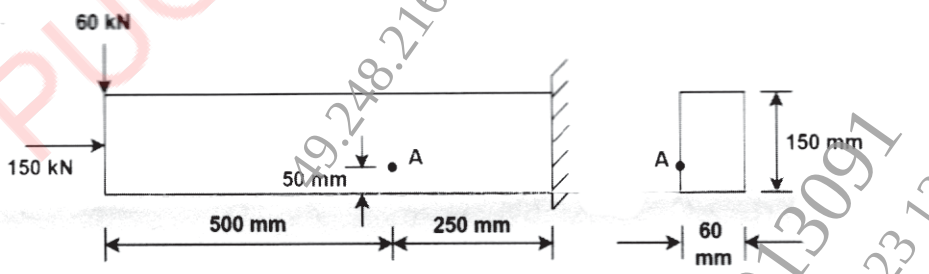

Fig. 3