Total No. of Questions : 8]

SEAT No. :

P606

[Total No. of Pages : 4

[5869] - 221
S.E. (Mech. / Sandwich)
SOLID MECHANICS
(2019 Pattern) (Semeser - III)

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 the suitable data, if necessary.***

Q1) a) A cast iron pipe of internal diameter 450 mm is 15 mm thick and is supported on a span of 8 m. Find the maximum stress in the pipe when it is full of water. Take specific weight of cast iron = 71600 N/m^3 and that of water = 9810 N/m^3. **[9]**

b) A simply supported beam carries a uniformly distributed load of intensity 30 N/mm over the entire span of 1 metre. The cross section of the beam is a T-section having the dimension as shown in figure 1. Calculate the maximum shear stress for the section of the beam. **[9]**

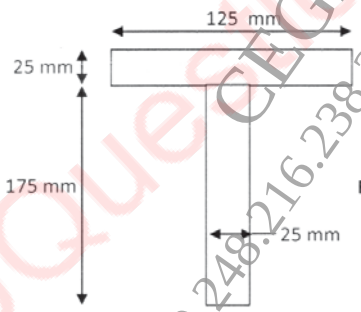

Figure 1.

OR

Q2) a) A horizontal girder of steel having uniform section is 14 meters long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 meters and 4.5 meters from the two ends respectively. I for the section of the girder is 16×10^8 mm^4 and E_s = 210 kN/mm^2. Calculate the deflections of the girder at points under the two loads. Find also the maximum deflection. **[9]**

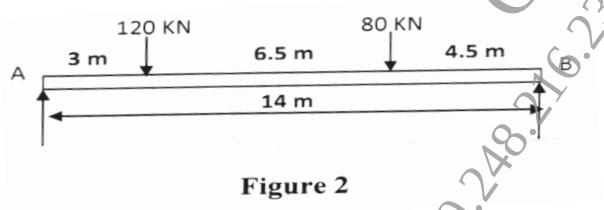

Figure 2

P.T.O.

b) The beam section as shown in figure 3, is subjected to bending moment of 8.75 kNm. Determine **[9]**

i) The force on the top flange

ii) The moment of this force about the neutral axis.

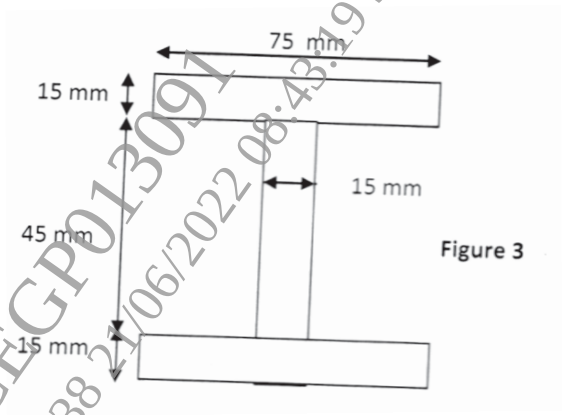

Figure 3

Q3) a) Determine the torque that can be applied to a solid shaft of 20 mm diameter without exceding an allowable shearing stress of 65 N/mm^2. What torque can be applied if the shaft is replaced by a hollow shaft of same sectional area with the inner diameter equal to half its outer diameter? **[9]**

b) A square column of wood is 2.5 m long with pinned ends. Taking a factor of safety of 2.5 in computing Euler critical load and also taking the allowable compressive stress as 12 N/mm^2, find the size of the cross-section, if the column has to safety support,

i) 150 kN

ii) 275 kN. Take E = 1.3 × 10^4 N/mm^2. **[8]**

OR

Q4) a) A hollow shaft 1.60 m long has an outer diameter of 42 mm and is subject to a torque of 900 Nm. If the permissible shear stress is 75 N/mm^2 and the angle of twist shall not exceed 4°, find the largest internal diameter. Take C = 7.7 ×10^4 N/mm^2. **[9]**

b) Find the greatest length of a mild steel rod 25 mm X 25 mm which can be used as a compression member with one end fixed and the other end free to carry a working load of 35 kN. Allow a factor of safety of 4. Take α = 1/7500 and f_c = 320 N/mm^2. **[8]**

Q5) a) A 75 mm diameter solid shaft is supported on end bearing 4 m apart. It carries a pulley weighing. 1.75 KN at its centre. It is subjected to a torque of 1.5 kNm. Ignoring the weight of the weight of the shaft, determine **[9]**

i) Equivalent torque to produce the same maximum shear stress.

ii) The maximum shear stress and

iii) The principal stresses.

b) A steel specimen is subjected to the following principal stresses **[9]**

i) 120 N/mm^2

ii) 60 N/mm^2 tensile and 30 N/mm^2 compressive. If the proportionality limit for the steel specimen is 250 N/mm^2. Find the factor of safety according to

1) The maximum principal stress theory
2) The maximum principal strain theory
3) The maximum shear stress theory and
4) The strain energy theory. Take Poisson's ratio (1/m) = 0.3

OR

Q6) a) A rectangular block of material is subjected to stresses on perpendicular faces as shown in figure 4. Using Mohr's circle of stress, find **[9]**

i) The normal and shear stresses on a plane for which θ = 30°.
ii) The magnitude of the principal stresses and the inclination of the planes on which principal stresses act.

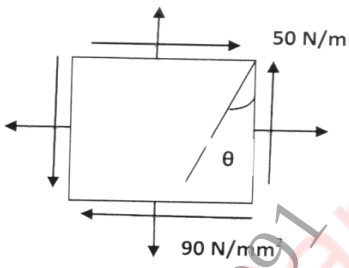

figure 4

b) A bolt is subjected to an axial pull of 8kN and a transverse shear force of 3 kN. Determine the diameter of the bolt required based on **[9]**

i) The maximum principal stress theory.
ii) The maximum shear stress theory.
iii) The maximum strain energy theory.

Take elastic limit in simple tension equal to 270 N/mm^2 and Poisson's ratio = 0.3. Adopt a factor of safety equal to 3.

Q7) a) The wide-flange beam is subjected to the loading shown in figure 5. Determine the principal stress in the beam at point A, which is located at the top of the web. Although it is not very accurate, use the shear formula to determine the shear stress. Show the result on an element located at this point. **[8]**

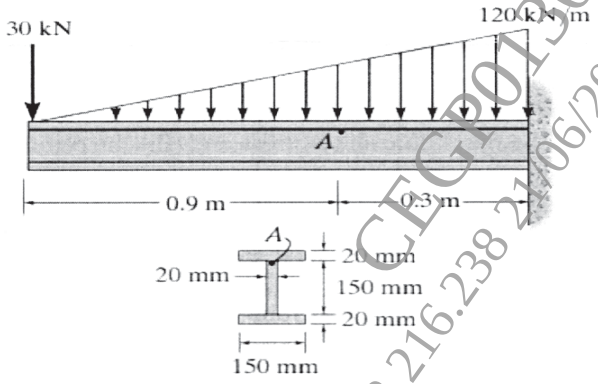

figure 5

b) Determine the principal stress in the beam at point A. **[9]**

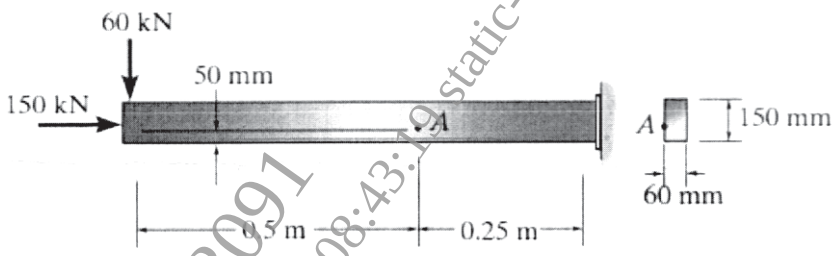

figure 6

OR

Q8) a) The wood beam is subjected to a load of 12 kN. Determine the principal stress at point A and specify the orientation of the element. **[8]**

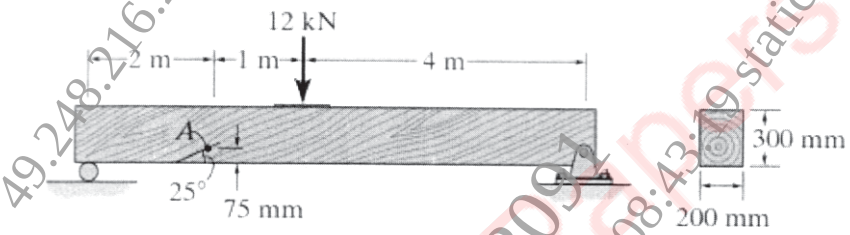

figure 7

b) The T-beam is subjected to the distibuted loading that is applied along its centerline as shown in figure 8. Determine the principal stress at point A and show the results on an elements located at this point. **[9]**

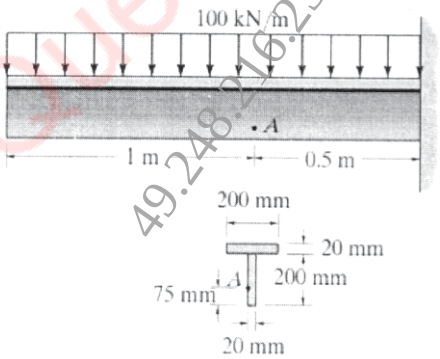

figure 8