Hall Ticket No | | | | | | | | | | | Question Paper Code: AME004

# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**

Four Year B.Tech III Semester End Examinations (Regular) - November, 2018

**Regulation: IARE – R16**

## MECHANICS OF SOLIDS

**Time: 3 Hours** **(ME)** **Max Marks: 70**

**Answer ONE Question from each Unit**
**All Questions Carry Equal Marks**
**All parts of the question must be answered in one place only**

### UNIT – I

1. (a) Discuss about the relationship between stress and strain. **[7M]**

   (b) A rod 150 cm long and a diameter 2 cm is subjected to an axial pull of 20 kN. If the modulus of elasticity of the material of the rod is 2 X $10^5$ N/$mm^2$; determine the stress, strain and elongation of rod. **[7M]**

2. (a) Derive an expression for calculating the stress in a bar when it is subjected to a sudden load P from a height h, having length l, cross sectional area A and young's modulus E. **[7M]**

   (b) A 2.2cm diameter copper rod passes centrally through a steel tube of 5cm internal diameter and 7cm external diameter. While at $50^0$C the ends are rigidly fastened together. Find the intensity of stress in each metal if heated to $150^0$C.Take $E_s$ = 2 X $10^5$ N/$mm^2$ $\alpha_s$ = 12 X $10^{-6}/^0$ C $E_c$ = 1.2 X $10^5$ N/$mm^2$ $\alpha_C$ = 18 X $10^{-6}/^0$ C. **[7M]**

### UNIT – II

3. (a) Derive the equation for shear force and bending moment diagram for a cantilever beam of length l, when it is is subjected to a point load of W at a distance of l from the fixed end. **[7M]**

   (b) A simply supported beam of length 8m is subjected to a point loads of 2 KN, 5 KN and 2 KN at the distances of 2m , 4m and 6m from left end. Draw the shear force and bending moment diagram for the beam. **[7M]**

4. (a) Draw the shear force and bending moment diagrams of a simply supported beam of length 7 m and carrying uniformly distributed loads as shown in Figure 1. **[7M]**

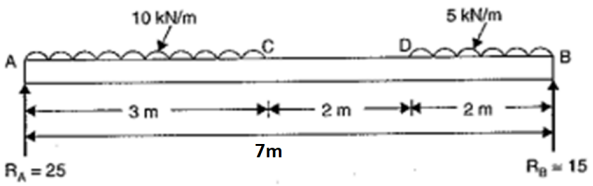


Figure 1

(b) Draw the shear force and bending moment diagrams of a overhanging beam carrying UDL of 2 kN/m over the entire length and a point load of 2 kN as shown in Figure 2. **[7M]**

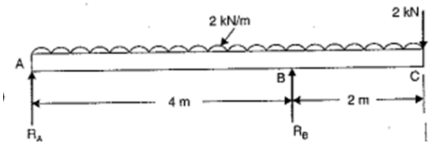


Figure 2

## UNIT – III

5. (a) Briefly discuss about the theory of simple bending. **[7M]**

   (b) Calculate the maximum stress induced in a cast iron pipe of external diameter 40 mm, of internal diameter 20 mm and of length 4 m when the pipe is supported at its ends and carries a point load of 80 N at its centre. **[7M]**

6. (a) Calculate the ratio of Maximum shear stress and average shear stress for a circle of radius r. The beam is considered as cantilever beam with downward load. **[7M]**

   (b) A beam of I shape, having the dimensions of flange width b =100 mm and thickness of flange 10 mm, web height 250 mm and thickness 15 mm. The loads on the beam produce a shear force of 35 kN at the cross section under consideration. Draw the shear stress distribution across the section. **[7M]**

## UNIT – IV

7. (a) Derive the expression for maximum principal stress theory. **[7M]**

   (b) The tensile stresses at a point across two mutually perpendicular planes are 120 N/$mm^2$ and 60 N/$mm^2$. Determine the normal, tangential and resultant stresses an a plane inclined at 30 degree to the axis of the minor stress. **[7M]**

8. (a) Explain the construction of Mohr's circle for two like stresses $\sigma$ and $2\sigma$ on two mutually perpendicular planes with a shear stress $\sigma/2$. **[7M]**

   (b) At a point in a strained material on plane BC there are normal and shear stresses of 200N/$mm^2$ and 340N/$mm^2$ respectively . On plane AB , perpendicular to plane BC, there are normal and shear stresses of 180N/$mm^2$ and 340N/$mm^2$ respectively as shown in Figure 3. Determine the following

   i) Principal stresses and location of the planes on which they act.

   ii) Maximum shear stress and the plane on which they act. **[7M]**

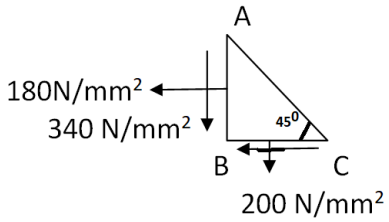


Figure 3

## UNIT – V

9. (a) Derive the torsion equation of a circular shaft which is fixed at one end and free at another end. **[7M]**

   (b) A composite shaft consists of a steel rod 60 mm diameter surrounded by a closely fitting tube of brass. Find the outside diameter of the tube so that when a torque of 1000 Nm is applied to the composite shaft, it will be shared equally by the two materials. Take C for steel = 8.4 X $10^4$ N/$mm^2$ and C for brass = 4.2 X $10^4$ N/$mm^2$. **[7M]**

10. (a) Derive the expression for polar section modulus of a circular shaft. **[7M]**

    (b) A thin cylindrical of internal diameter 1.25 m contains a fluid at an internal pressure of 15 N/$mm^2$. Determine the maximum thickness of the cylinder if:

    (i) The longitudinal stress is not to exceed 30 N/$mm^2$.

    (ii) The circumferential stress is not to exceed 45 N/$mm^2$. **[7M]**

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