# B. Tech. Examination 2022-23

**(Special Carry Over Paper)**

## ENGINEERING MECHANICS

*Time : Three Hours]* *[Maximum Marks : 60*

**Note :–** (i) Attempt all questions.

(ii) Any missing data assumed suitably.

## SECTION–A

1. Attempt all parts of the following : 8×1=8

(a) Write the statement of Varignon's theorem.

(b) What are the conditions for equilibrium of concurrent and non-concurrent force system?

(c) Define cantilever beam with diagram.

(d) Explain point of contra flexure.

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(e) Write the formula for moment of inertia of a triangle about its base, if base length is b and height is h.

(f) State D'Alembert's principle.

(g) Define Hook's law.

(h) Write the relation among modulus of elasticity, bulk modulus and modulus of rigidity.

## SECTION – B

2. Attempt any two parts of the following : 2×6=12

(a) Determine the magnitude, direction and position of the resultant force system as shown in figure (1) assuming the triangle is equilateral having side length 100 mm :

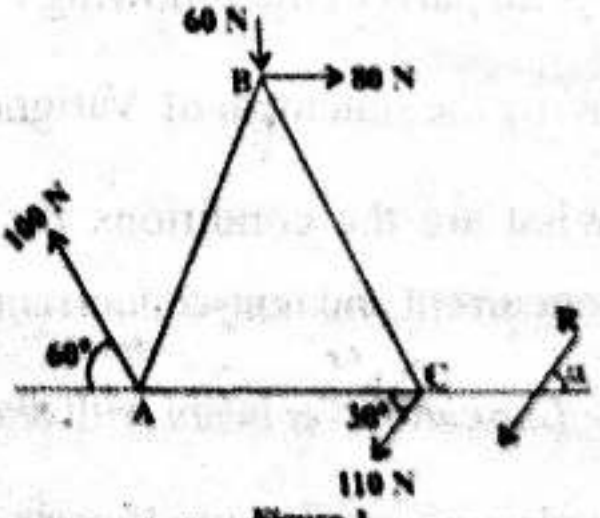



Figure-1

(b) Draw the shear force and bending moment diagram for the cantilever beam as shown in figure-2 :

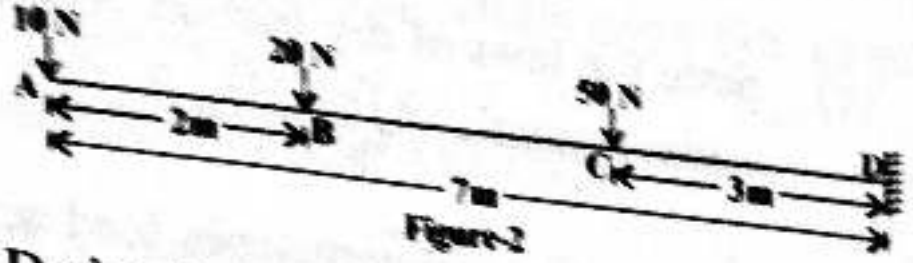


Figure-2

(c) Derive the expression of moment of inertia of a triangle about the base.

(d) Define the following terms :

(i) Thermal stress

(ii) Strain energy

(iii) Longitudinal and lateral strain

## SECTION–C

**Note :–** Attempt all questions. Attempt any two parts from each question. 5×8=40

3. (a) The resultant of two forces, one of which is double the other is 260 N. If the direction of the larger force is reversed and the other remains unaltered, the resultant reduces to 180 N. Determine the magnitude of the forces and the angle between the forces.

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(b) Derive the relationship between tension on tight side ($T_2$) and slack side ($T_1$) in a rope.

(c) State the laws of dry friction. Also define the static, dynamic and limiting friction.

4. (a) Discuss the different types load acting on a beam.

(b) Derive the relation among load intensity, shear force and bending moment.

(c) find the forces in all the members of the truss as shown in figure-3 :

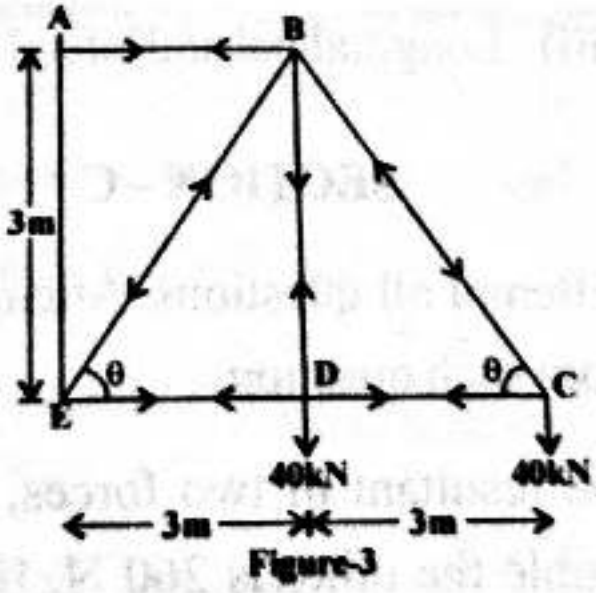



Figure-3

5. (a) Discuss the following with neat diagram :

(i) Parallel axis theorem

(ii) Perpendicular axis theorem

(b) The motion of a cam is defined by the relation $\theta = t^3 - 8t + 15$, where $\theta$ is expressed in radian and t in seconds. Determine the angular displacement, angular velocity and angular acceleration after 4 seconds.

(c) Discuss work, power and energy. Give their units also. Also explain the work energy principle.

6. (a) Draw stress-strain diagram for mild steel and explain the salient points on it.

(b) A circular rod of diameter 16 mm and 600 mm long is subjected to a tensile force 40 kN. The modulus of steel is taken as 200 kN/mm$^2$. Find stress, strain and elongation of the bar due to applied load.

(c) Define the following :

(i) Stress and type of stress

(ii) Strain and type of strain

(iii) Poisson's ratio