

B. TECH.

**SECOND SEMESTER EXAMINATION, 2003-2004
ENGINEERING MECHANICS**

Time : 2 Hours

Total Marks : 50

Note : Attempt ALL the questions.1. Answer any *FOUR* of the following :— (3·5×4)

- (a) Find the resultant of the force system given in Fig. 1 below :—

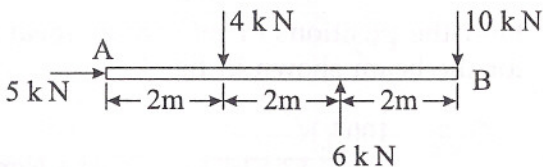


Figure-1

- (b) A bell crank lever is subjected to the force system shown in the following figure 2. If the lever is in equilibrium, find the magnitude of the force F :—

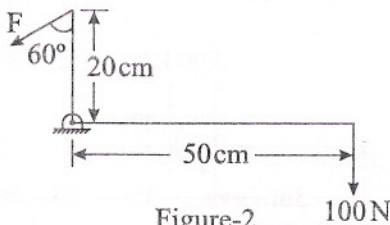


Figure-2

- (c) A cylinder of weight 1000 N and radius 40 cm is in equilibrium as shown in the figure-3. Find tension in the rope AC. Length of BC is 2 m.

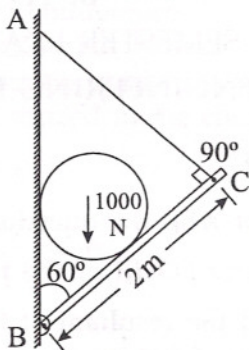


Figure-3

- (d) Find the positions of maximum shear force for the beam shown in fig. 4.

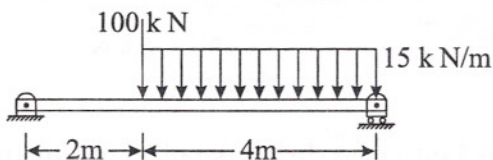


Figure-4

- (e) Find the expression for bending moment M in the range of $3 < x < 6$ for the beam shown in the figure-5 below :—

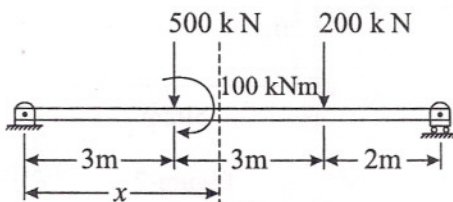


Figure-5

- (f) The following fig. 6, shows bending moment diagram for certain beam in equilibrium. Ascertain the type of support(s) on the beam and draw the shear force diagram for the same :—

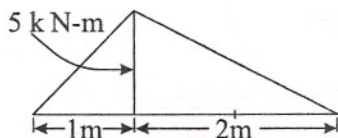


Figure-6

2. Attempt any *TWO* of the following :— (6×2)

- (a) Find the forces in members BC, BE, FE of the truss shown in fig. 7.

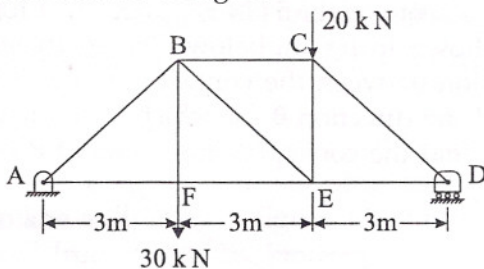


Figure-7

- (b) Find the moment of inertia of the area, shown in fig. 8, about centroidal axes parallel to the x axis.

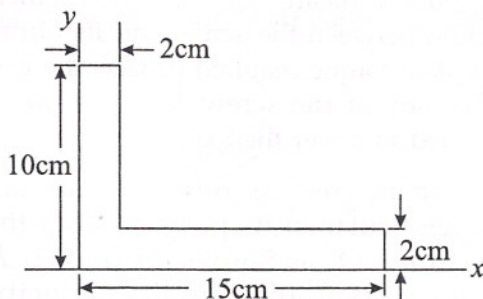


Figure-8

- (c) A sphere of radius 10 cm and mass 25 kg is attached to a thin rod of length 1 m and mass 3 kg. It is free to rotate about the axis shown in fig. 9 below. Find the moment of inertia of the mass system about the axis of rotation :—

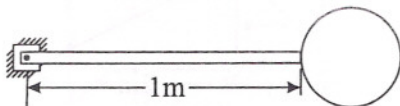


Figure-9

3. Answer any TWO parts :— (6×2)

- (a) A block of weight 5 kN is pulled by a force P as shown in fig. 10 below. The coefficient of friction between the contact surfaces is 0.35. Find the direction θ for which P is minimum and find the corresponding value of P :—

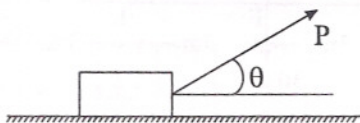


Figure-10

- (b) A screw jack carries a load of 400 N. It has a square thread single start screw of 20 mm pitch and 50 mm mean diameter. The coefficient of friction between the screw and its nut is 0.27. Calculate torque required to raise the load and efficiency of the screw. What is the torque required to lower the load ?
- (c) A disc is free to rotate about an axis perpendicular to its plane passing through the hinge O , as shown in fig. 11. At the given instant the angular velocity and angular acceleration of the disc are 20 rad/s

and 5 rad/s^2 respectively. Find the linear velocity and acceleration of points A and B.

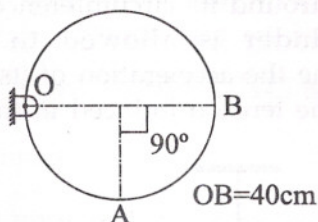


Figure-11

4. Attempt any TWO parts :—

(6×2)

- (a) (i) Define the principle of virtual work.
 (ii) State and explain the D'Alemberts principle.

(b) A solid cylinder of mass 20 kg and radius 10 cm rolls without slipping on an inclined plane as shown in figure 12. It is allowed to roll from rest ($t=0$). Find—

- (i) The kinetic energy of cylinder at $t = 3$ seconds,
 (ii) The angular momentum of the cylinder about its own axis at $t = 3$ seconds,
 (iii) The acceleration of centre of mass at $t = 3$ seconds.

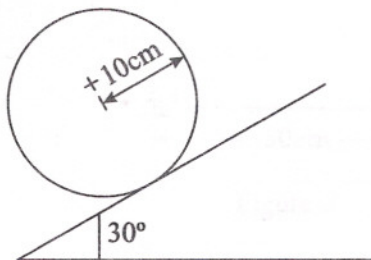


Figure-12

- (c) A light circular cylinder of mass ' m ' and radius ' r ' is suspended from a thread that is wound around its circumference (Fig. 13). If the cylinder is allowed to fall freely, determine the acceleration of its mass centre G and the tension induced in the chord.

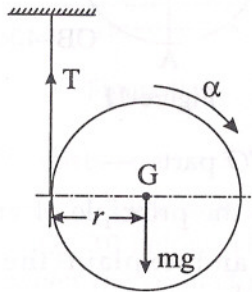


Figure-13