

B.Tech. Degree I & II Semester (Combined) Examination June 2013

IT/CS/EC/CE/ME/SE/EE/EI/EB/FT 1104 ENGINEERING MECHANICS
(2012 Scheme)

Time : 3 Hours

Maximum Marks : 100

PART A
(Answer ALL questions)

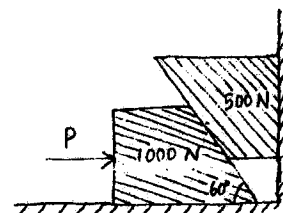
(8 × 5 = 40)

- I. (a) What do you mean by equilibrium of a particle? What is equilibrium law? What are the conditions of equilibrium for a coplanar force system?
- (b) State and prove Pappus's theorem for areas and volumes.
- (c) What is the significance of principal axes of an area in connection with second moment of area?
- (d) How do the analyses of a plane truss and plane frame, differ? Mention the assumptions made in their analysis.
- (e) Derive the expressions for velocity and displacement of a particle undergoing constantly accelerated motion along a straight line.
- (f) State D'Alembert's principle with reference to rectilinear translation. Mention its usefulness in solving kinetics problem.
- (g) Define momentum and moment of momentum of a particle with reference to curvilinear translation.
- (h) Derive an expression for the period of oscillation of a compound pendulum.

PART B

(4 × 15 = 60)

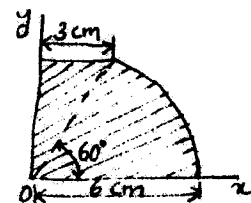
- II. Referring to the figure, the coefficients of friction are as follows:
0.25 at the floor, 0.30 at the wall and 0.20 between the blocks. Find the minimum value of a horizontal force P applied to the lower block that will hold the system in equilibrium. Also calculate the minimum force 'P' that may be applied horizontally, without disturbing equilibrium.



(15)

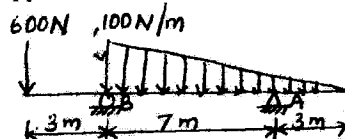
OR

- III. (a) Locate the centroid of the shaded area shown in the figure.



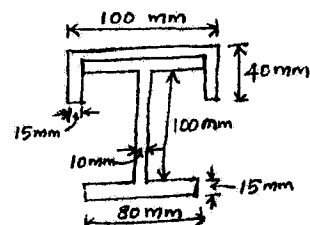
(8)

- (b) Calculate the reactions at supports A and B of the beam shown, below.



(7)

- IV. Calculate the second moment of area (moment of inertia) of the following composite area with respect to a horizontal and vertical axis passing through its centroid. The thickness of the channel section is uniform and is 15mm. The thickness of the flanges of the I-section is 15mm and that of the web is 10mm.

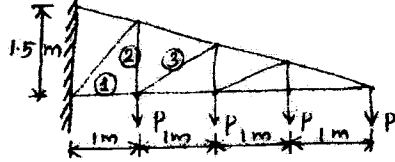


(15)

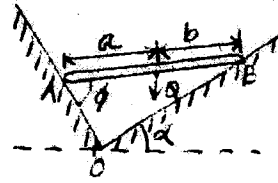
OR

(P.T.O.)

- V. (a) Determine the forces in members 1, 2 and 3 of the truss, shown, below. (8)



- (b) A rigid bar AB is supported in a vertical plane by mutually perpendicular smooth surfaces OA and OB as shown in the figure. Using the principle of virtual work, calculate the angle ϕ defining the configuration of equilibrium of the system. (7)

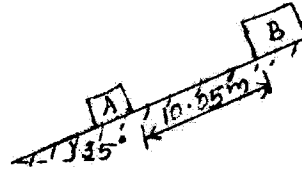


- VI. (a) The motion of a particle is defined by the relation $x = 7.5 + 22.5t - 13.5t^2 + 1.5t^3$ where 'x' is in metre and 't' in sec. Determine (i) the position when the velocity is zero and (ii) the position and total distance traveled when the acceleration is zero. (8)

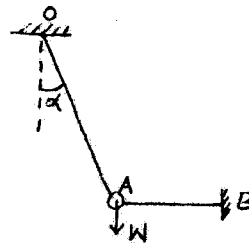
- (b) A body moving with uniform acceleration is observed to travel 33m in the 8th second and 53m in the 13th second of its travel. Calculate its initial velocity and uniform acceleration. (7)

OR

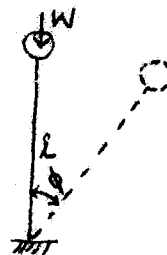
- VII. Two blocks A and B are held on an inclined plane as shown in the figure. The coefficients of friction for blocks A and B with the inclined plane are 0.3 and 0.2 respectively. If the blocks begin to slide down simultaneously, calculate the distance travelled and time taken by each block before block B touches block A. When they continue to move as a single unit, determine the contact force exerted between them. $W_A = 300\text{N}$ and $W_B = 500\text{N}$. (15)



- VIII. (a) A particle A of weight W is suspended in a vertical plane by two strings as shown in the figure. Determine the tension in the inclined string OA (i) an instant before the horizontal string AB is cut and (ii) an instant after the string is cut. Assume the string OA as inextensible. (8)



- (b) If the pendulum in the figure is released from rest in its position of unstable equilibrium, find the value of the angle ϕ defining the position in its downward fall at which the axial force in the rod changes from compression to tension. (7)



OR

- IX. (a) The armature of an electric motor has an angular speed of 1800 rpm at the instant when the power is cut off. (i) If it comes to rest in 6 sec, calculate the angular deceleration ' α ' assuming that it is constant. (ii) How many complete revolution does the armature make during this period? (7)

- (b) A homogenous square plate of weight W and having dimensions 'a' hangs in a vertical plane by two pins A and B as shown in the figure. Calculate the horizontal and vertical components of the reaction at A an instant after the pin at B is removed. (8)

