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Question Paper Code : R 3822

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

First Semester

Civil Engineering

GE 131 — ENGINEERING MECHANICS

(Regulation 2001)

(Common to all branches of B.E/B.Tech. except Marine Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Two forces $P = 100$ kN and $Q = 200$ kN act at the origin. P is directed towards a point $(-2, 3, -5)$ metres and Q towards $(6, -8, -4)$ metres. What is the result and corresponding unit vector?

2. Define principle of transmissibility of forces.

3. Two forces $\vec{F}_1 = 5\vec{i}$ and $\vec{F}_2 = 3.6\vec{j}$ pass through a point whose co-ordinates are $(2, 1)$. Calculate the moment of the force about the origin.

4. Explain perpendicular axis theorem.

5. Define product of inertia.

6. Give the centroid of quarter circular arc.

7. Give the equation for belt friction and explain the components.

8. What is instantaneous velocity and instantaneous acceleration?

9. State the principle of work and energy.

10. What do you mean by general plane motion?

PART B — (5 × 16 = 80 marks)

11. (a) If five forces act on a particle as shown in Fig. Q 11 (a) determine the magnitude and direction of resultant force.

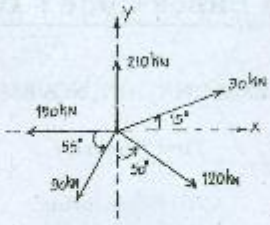

Fig. Q 11 (a)

Or

(b) A tripod is acted upon by forces at 'p' as follows: 20 kN along positive x direction , 40 kN along the negative y direction. Three legs rest on ground at points $A(-4, 0, 0)$, $B(5, 0, 2)$ and $C(-2, 0, -3)$. Height of 'p' above origin is 10 m. Coordinate of $P(0, 10, 0)$. Find the forces in legs of tripod.

12. (a) A force acts at the origin of a co-ordinate system in a direction defined by the angle $\theta_x = 69.3°$ and $\theta_z = 57.9°$. Knowing that the y component of the force is –174 N, determine

(i) the angle θ_y

(ii) the other components and the magnitude of the force

(iii) projection of this force on xz plan and its magnitude and

(iv) moment of this force about a point of co-ordinate $(2, 3, 4)$ and its magnitude. (16)

Or

(b) Four forces and a couple are applied to a rectangular plate as shown in Fig Q. 12 (b). Determine the magnitude and direction of the resultant force-couple system. Also determine the distance x from o along x-axis where the resultant intersects. (16)

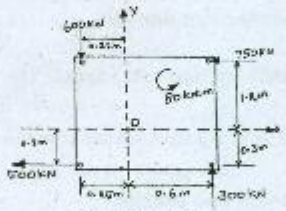

Fig Q. 12 (b)

13. (a) (i) An inverted T section is shown in Fig Q. 13 (a) (i). Calculate the moment of inertia of the section about XX axis parallel to the base and passing through the centroid. Also calculate radius of gyration. (12)

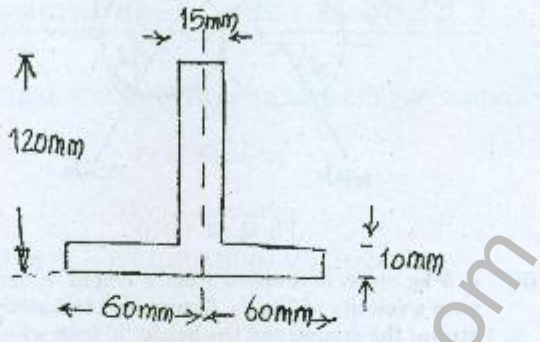

Fig Q 13 (a) (i)

(ii) Derive the expression for mass moment of inertia about the vertical centroidal axis of a thin rectangular plate of width '*b*' , depth '*d*' and thickness '*t*'. (4)

Or

(b) Locate the centroid and find I_{xx}, I_{yy} about the axes passing through the centroid of lamina shown in Fig Q. 13 (b)

Fig Q. 13 (b)

14. (a) A ladder of weight 400 N and 6 m long is placed against a vertical wall. The angle of ladder makes 30° with respect to the wall. The coefficient of friction between the wall and the ladder is 0.25 and that between ladder and floor is 0.3 . How high a man of weight 1200 N can climb, before the ladder begins to slip.

Or

(b) A belt is running over a pulley of diameter 1.2 m at 300 rpm. The angle of contract is 150° and coefficient of friction is 0.35. If the maximum tension in the belt is 500 N, determine the power transmitted by it.

15. (a) (i) Two identical spheres A and B strike each other as shown in figure 15 (a) (i). If $e = 0.9$, find the velocity and the direction of each ball after impact. (10)

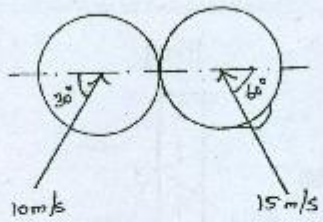

Fig Q. 15 (a) (i)

(ii) A 3 kg stone is dropped from a height 'h' and strikes the ground with a velocity of 30 m/s. Determine the kinetic energy of stone as it strikes the ground and the height 'h' from which it was dropped. (6)

Or

(b) (i) The system shown in figure 15 (b) (i) is released from rest. Block A and B weight 500 N and 800 N respectively. The coefficient of friction between block A and plane is 0.2. Find the acceleration of each block, the distance moved and the velocity of each block after 5 seconds . Also find the tension in the cable. (8)

Fig Q. 15 (b) (i)

(ii) Each of the two slender rods shown in figure 15 (b) (ii) is 0.75 m long has mass of 6 kg. The system is released from rest when $\beta = 60°$. Determine the angular velocity of the rod when $\beta = 20°$ and velocity at D at the same instant. (8)

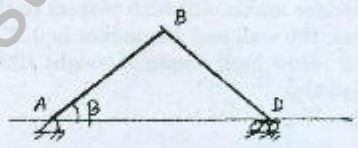

Figure Q. 15 (b) (ii)