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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Second Semester

Civil Engineering

GE 1151 — ENGINEERING MECHANICS

(Common to all Branches and B.E (Part - Time) First Semester R 2005)

(Regulation – 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A 100 N force acts at the origin in a direction defined by the angles $\theta_x = 75°$ and $\theta_y = 45°$. Determine θ_z and the component of the force in the z direction.

2. State the principle of Transmissibility.

3. What is a couple? What is the moment of couple?

4. State Varignon's theorem. - 2.3

5. What are principal axes? - 3.85

6. State the perpendicular axis theorem. - 3.44

7. State the Newton's Second law of motion. - 4.58

8. Define the term 'Coefficient of restitution'.

9. Define the term 'angle of repose'.

10. What is meant by Centrode?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Check whether the particle 'O' shown in figure Q. 11 (a) is in equilibrium under the given system of forces. If not determine the magnitude and direction of the force necessary to keep the particle in equilibrium. (8)

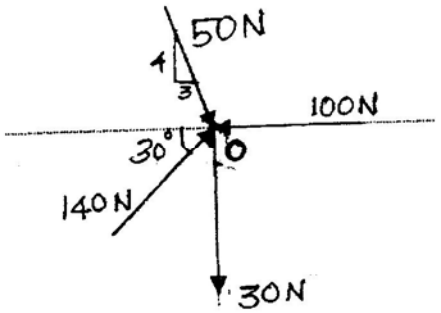

Figure Q. 11 (a)

(ii) A force is represented in a vector form P = 20i–8j–14k, N. Determine the projection of this force on a line which originate from (2,–4,5) and passes through the point (5,2,–4). Also find the angle between the force and the line. (8)

Or

(b) A rigid bar ABCD, is subjected to a system of forces as shown in figure Q. 11(b). Determine the resultant of the force system and also deduce the system to a single force and couple at A.

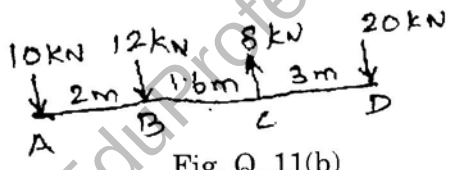

Fig. Q. 11(b)

12. (a) (i) A force of magnitude 200 N is acting along the line joining P(2, 4, 8) m and Q(4, 7, 10) m. find the moment of the force about the point R(7, 10, 15) m. (6)

(ii) A beam AB, 1.7 m long is loaded as shown in figure Q. 12 (a) (ii). Determine the reactions at supports A and B. (10)

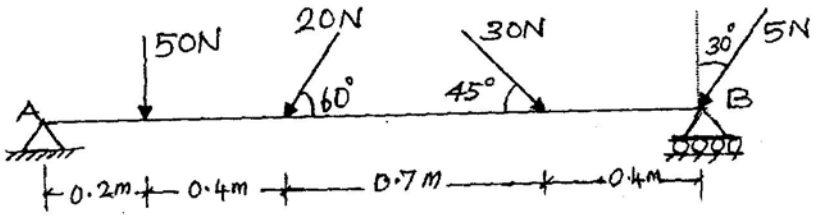

Figure Q. 12 (a) (ii)

Or

(b) (i) What is meant by equilibrium of a rigid body? What are the conditions of equilibrium for a rigid body in three dimension? (4)

(ii) A vertical pole of 9 m high is held in position by three guy wires as shown in figure Q. 12 (b). The bottom of the pole is supported at the ground using a ball and socket arrangement. If the force in the cable BE is 1260 N, determine the forces in other cables and also the reaction at the bottom of the pole. (12)

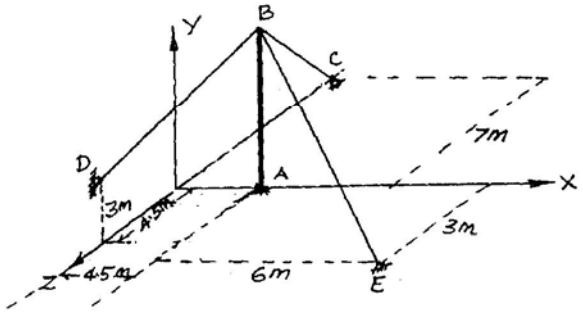

Figure Q. 12 (b)

13. (a) (i) What is meant by polar moment of inertia? (3)

(ii) The cross-section of a hollow circular lamina is as shown in figure. Q 13 (a) (ii). Locate the position of the centroid of the net area and then work out the moments of inertia about both the horizontal and vertical centroidal axes. (13)

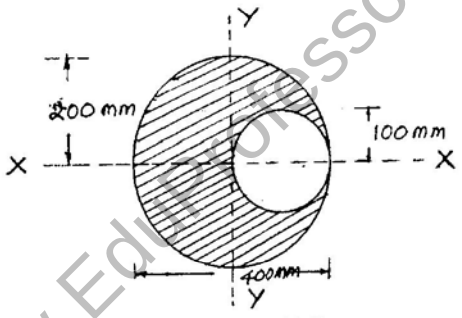

Fig. Q. 13(a)(ii)

Or

(b) (i) Find the second moment of area of the plane lamina shown in figure Q. 13 (b) (i) with respect to the given XX-axis. (8)

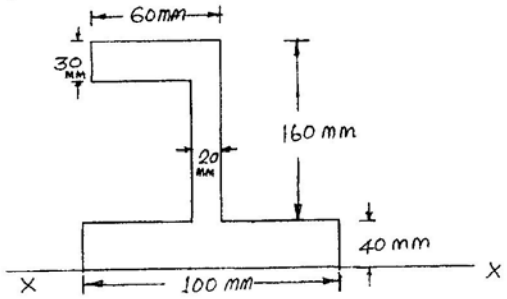

Figure Q. 13 (b) (i)

(ii) Derive the relation for mass moment of inertia of a solid sphere of radius 'r' about its diameter. (8)

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14. (a) (i) The angle of rotation of a body is given as the function of time by the equation, $\theta = \theta_0 + at + bt^2$ where θ_0 is the initial angular displacement, a and b are constants. Obtain the general expression for

(1) The angular velocity and

(2) The angular acceleration of the body.

If the initial angular velocity be (3π) radians per second and after two seconds the angular velocity is (8π) radians per second, find the constants a and b. (10)

(ii) A body of mass 50 kg moving with a velocity of 6 m/sec, collides directly with a stationary body of mass 30 kg. If the two bodies become coupled so that they move on together after the impact in the same direction. What is their common velocity? (6)

Or

(b) A bullet is fired from the top of a mountain of height 300 metre with a velocity of 200 m/s at an angle of elevation of 40° Determine the

(i) Maximum elevation reached by the bullet above the ground.

(ii) Horizontal distance between the point of firing and the point where the bullet will strike the ground and

(iii) Magnitude and direction of velocity with which the bullet will strike the ground. (16)

15. (a) A block weighing 1350 N is placed on an inclined plane whose inclination to the horizontal is 37°. A force of 450 N acts on the body in the upward direction parallel to the plane. Determine whether the block is in equilibrium or not, and also find the frictional force between the body and the plane. The coefficient of static and kinetic frictions are 0.25 and 0.20 respectively. (16)

Or

(b) (i) Find the ratio of tension in tight and in slack sides of a belt with contact angle of 160° with pulley. Assume the coefficient of friction $\mu = 0.22$. If the slack tension is 100 N, what is the value of tension on tight side? (6)

(ii) Two bodies of weight 40 N and 20 N are connected to the two ends of a light inextensible string, passing over a smooth pulley. The weight of 40 N is placed on a smooth horizontal surface while the weight of 20 N is hanging free in air. Find

(1) The acceleration of the system and

(2) The tension in the string.

Take $g = 9.81$ m/sec^2. (10)
