H 1314

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2006.

First Semester

Civil Engineering

GE 131 — ENGINEERING MECHANICS

(Common to All Branches except Marine Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define equivalent system of forces.

2. A vector A is equal to $2i - 3j + 2k$. Find the projection of this vector on the line joining the point $P(-3, 2, 1)$ and $Q(2, -2, -1)$.

3. The sum of two concurrent forces F_1 and F_2 is 300 N and their resultant is 200 N. The angle between the force F_1 and resultant is 90°. Find the magnitude of each force.

4. What are the necessary and sufficient conditions of equilibrium of rigid bodies in two dimensions and in three dimensions?

5. State and prove perpendicular axis theorem.

6. Explain the theorem of Pappus and Guldinus.

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

8. What is instantaneous velocity and instantaneous acceleration?

9. A body is moving with a velocity of 4 m/s. After five seconds the velocity of body becomes 14 m/s, find the acceleration of the body.

10. Explain D'Alembert's principle.

PART B — (5 × 16 = 80 marks)

11. (i) Explain dry friction and give the laws of dry friction. (6)

(ii) The forces acting on the block are shown in Figure Q. 11 (ii). Determine whether the block is in equilibrium and find the magnitude and direction of the friction force. Take $\mu_s = 0.35$ and $\mu_k = 0.25$. (10)

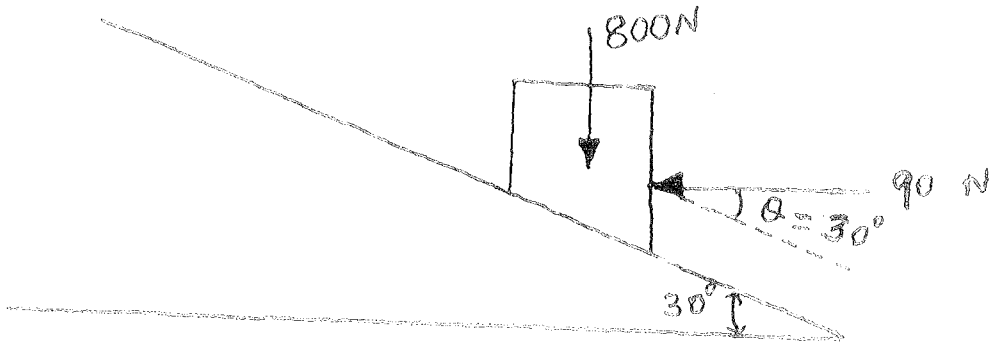

Fig. Q. 11 (ii)

12. (a) Two spheres each of weight 500 N and of radius 100 mm rest in a horizontal channel of width of 360 mm as shown in Figure Q. 12 (a). Find the reactions on the points of contact A, B and C. Assume all the surfaces of contact are smooth. (16)

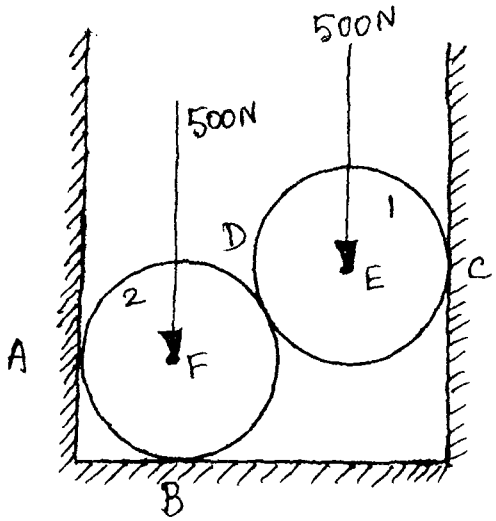

Fig. Q. 12 (a)

Or

(b) Determine the magnitude and direction of force 'F' shown in Fig. Q. 12 (b) so that the particle A is in equilibrium. (16)

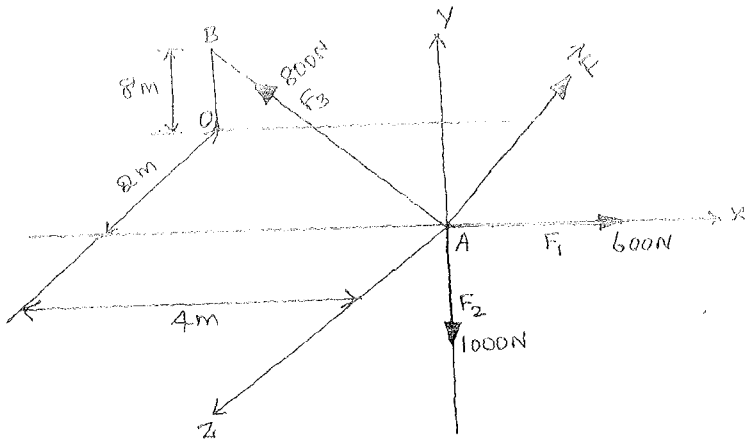

Fig. Q. 12 (b)

13. (a) Locate the centroid for the area shown in Fig. Q. 13 (a). (16)

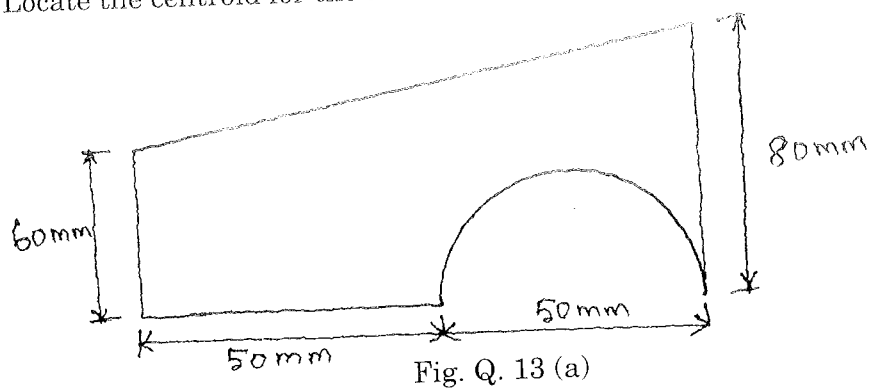

Fig. Q. 13 (a)

Or

(b) Find moment of inertia about 1–1 and 2–2 axes for the area shown in Fig. Q. 13 (b). (16)

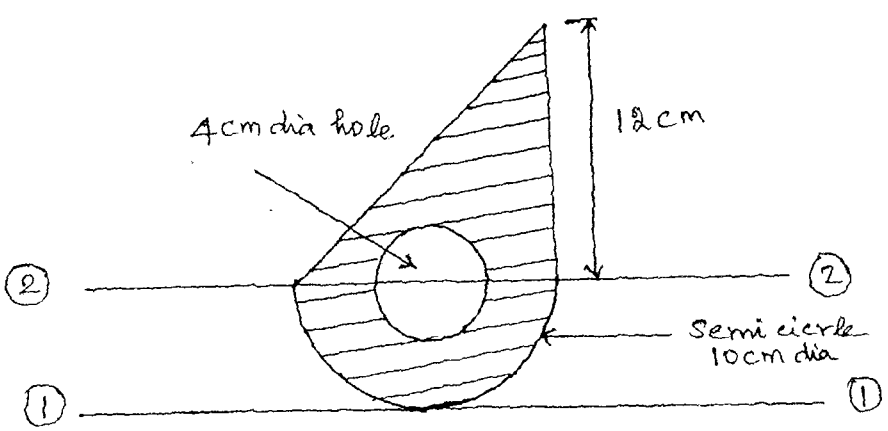

Fig. Q. 13 (b)

14. (a) Two electric trains A and B leave the same station on parallel lines. The train A starts with a uniform acceleration of 0.15 m/s^2 and attains a speed of 40 km/hr when the steam is reduced to keep the speed constant. The train B leaves 1 minute after, with a uniform acceleration of 0.3 m/s^2 to attain a maximum speed of 70 km/hr. When the train B will overtake the train A? (16)

Or

(b) A particle is projected in air with a uniform velocity 70 m/s at an angle of 40° with the horizontal. Determine

(i) horizontal range

(ii) the maximum height attained by the particle, and

(iii) the time of flight. (16)

15. (a) A fly wheel weighing 60 kN having radius of gyration 1 m loses its speed from 400 r.p.m. to 280 r.p.m. in 2 minutes. Determine

(i) the retarding torque acting on it

(ii) change in kinetic energy during the above period and

(iii) change in its angular momentum during the same period. (16)

Or

(b) A 120 kg pulley having a radius of gyration of 0.4 m is connected to two cylinders as shown in Fig. Q. 15 (b). Assume no axle friction and determine the angular acceleration of the pulley and the acceleration of each cylinder. (16)

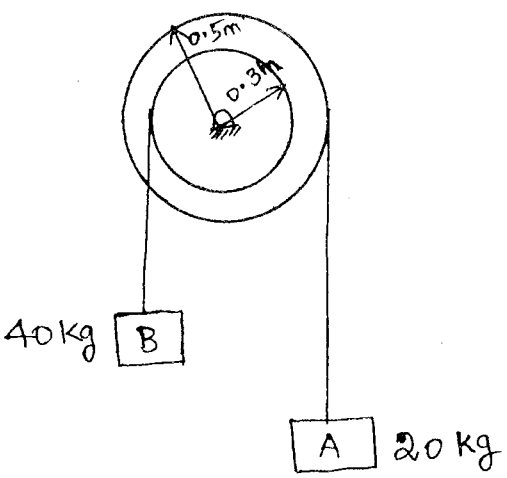

Fig. Q. 15 (b)

Time

1.

2.

3.

4.

5.

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11.