Reg. No. : | | | | | | | | | | | |

Question Paper Code : U4013

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

Second Semester

Civil Engineering

ME 2151 — ENGINEERING MECHANICS

(Common to Chemical Engineering, Plastics Technology, Petroleum Engineering, Polymer Technology, Mechanical Engineering, Automobile Engineering, Aeronautical Engineering, Textile Technology (Fashion Technology), Biotechnology, Marine Engineering, Production Engineering, Textile Technology)

(Regulation 2008)

Time : Three hours Maximum : 100 Marks

Answer ALL Questions

PART A — (10 × 2 = 20 Marks)

1. A force $\vec{F} = 9\hat{i} + 6\hat{j} - 15\hat{k}$ acts through the origin. What is the magnitude of the force and the angle it makes with X, Y and Z axis?

2. State the principal of transmissibility of forces with simple sketch.

3. Explain free body diagram with one example.

4. State Varignon's theorem.

5. State parallel axis theorem with simple sketch.

6. Distinguish between centroid and center of gravity.

7. Explain the difference between kinematics and kinetics.

8. A train running at 80 km/h is brought to a standing halt after 50 seconds. Find the retardation and the distance traveled by the train before it comes to a halt.

9. List out the different types of friction. What is coefficient of static friction?

10. A rigid body is acted upon by a force of 100 N, the velocity of body changes from 15 m/s to 25 m/s during a period of 50 s. Find the mass of body and the distance moved by the body during the time of interval.

PART B — (5 × 16 = 80 Marks)

11. (a) Two cylinder P and Q rest in channel as shown in the Figure 1. The cylinder P has diameter of 100 mm and weighs 200 N where as the cylinder Q has diameter of 180 mm and weighs 500 N. If the bottom

width of the box is 180 mm, with one side vertical and other inclined at 60°, determine the reactions at all the four points of contact.

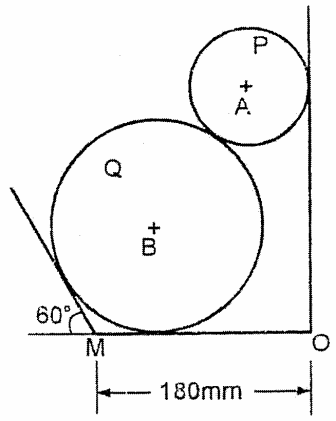

Figure 1

Or

(b) A horizontal force P normal to the wall holds the cylinder in the position shown in Figure 2. Determine the magnitude of P and the tension in each cable.

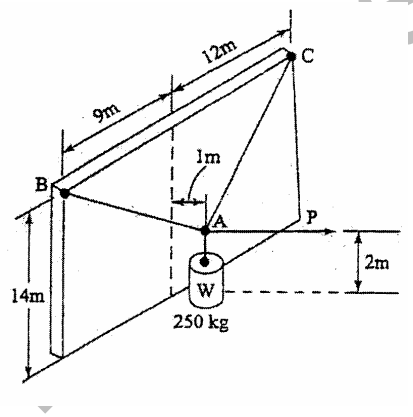

Figure 2

12. (a) The slab in Figure 3 is subjected to parallel forces. Determine the magnitude and direction of resultant force equivalent to the given force system and locate its point of application on the slab.

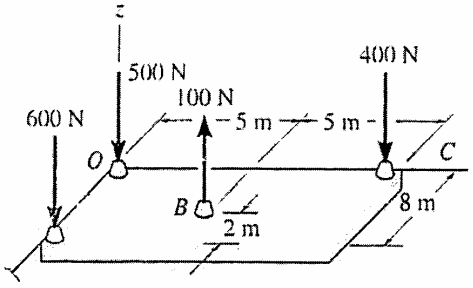

Figure 3

Or

(b) The lever ABC of a component of a machine is hinged at B, and is subjected to a system of coplanar forces as shown in Figure 4. Neglecting friction, find the magnitude of the force (P) to keep the lever in equilibrium. Also determine the magnitude and direction of the reaction at B.

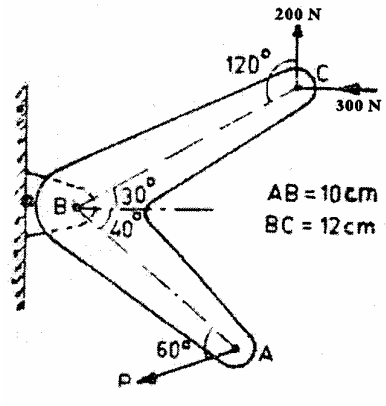

Figure 4

13. (a) Calculate the centroidal moment of inertia of the shaded area shown in Figure 5.

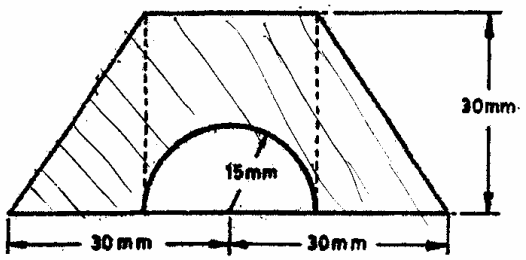

Figure 5

Or

(b) A steel forging consists of a 60 × 20 × 20 mm rectangular prism and two cylinders of diameter 20 mm and length 30 mm as shown in Figure 6. Determine the moments of inertia of the forging with respect to the coordinate axes, knowing that the density of steel is 7850 kg/m^3.

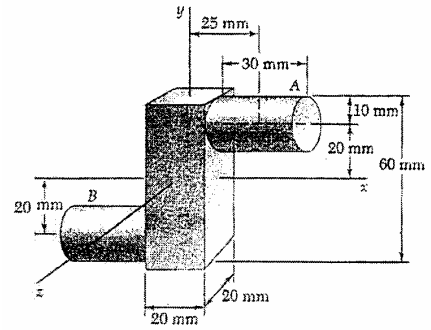

Figure 6

14. (a) Two trains A and B leave the same station on parallel lines. A starts with a uniform acceleration of 0.15 m/s^2 and attains the speed of 24 km/hour when the steam is reduced to keep speed constant. B leaves 40 seconds after with uniform acceleration of 0.30 m/s^2 to attain a maximum speed of 48 km/hour. When will B overtake A?

Or

(b) A ball of mass 2 kg, moving with a velocity of 3 m/sec, impinges on a ball of mass 4 kg moving with a velocity of 1 m/sec. The velocities of the two balls are parallel and inclined at 30° to the line of joining their centres at the instant of impact. If the coefficient of restitution be 0.5, find

(i) Direction, in which the 4 kg ball will move after impact;

(ii) Velocity of the 4kg ball after impact;

(iii) Direction, in which the 2 kg ball will move after impact; and

(iv) Velocity of the 4 kg ball after impact.

15. (a) Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shaft 1.95 m apart and are connected by a open belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rpm, if the maximum permissible tension in the belt is 1000 N, and the coefficient of friction between the belt and pulley is 0.25?

Or

(b) Two masses of 30 kg and 10 kg are tied to the two ends of a light string passing over a composite pulley of radius of gyration as 70 mm and mass 4 kg as shown in Figure 7. Find the pulls in the two parts of the string and the angular acceleration of the pulley.

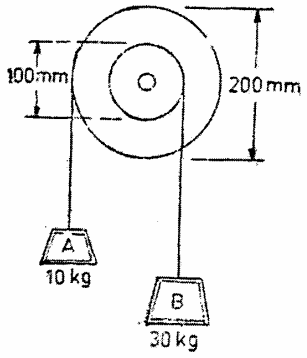

Figure 7