C 26474 (Pages : 4) Name.....

Reg. No.....

COMBINED FIRST AND SECOND SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, APRIL 2012

PTEN / EN 09 105 —ENGINEERING MECHANICS

(Common for all Branches)

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. What is a free body diagram ?
2. Define angle of friction.
3. State the first theorem of Pappus-Guldinus.
4. State D' Alembert's principle.
5. Define instantaneous center of rotation.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. An electric street lamp is suspended from a small ring B supported by two wires AB and CB, the ends A and C of which are on the same level as shown in Fig. 1. Assuming these wires to be perfectly flexible and neglecting their weights, find the force produced in each if the weight of the lamp is 15 N, the length of each wire, 10 m, and the sag DB, 4 m.

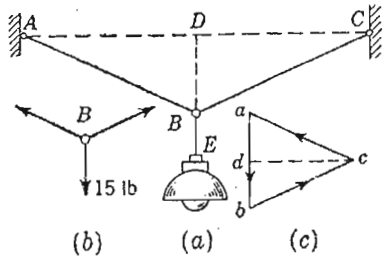


Fig. 1.

7. Find the frictional force for the block shown in Fig. 2 and state whether the block is in equilibrium or in motion. Also determine the additional force 'P' that must be added to 140 N force, to just move the block to the left.

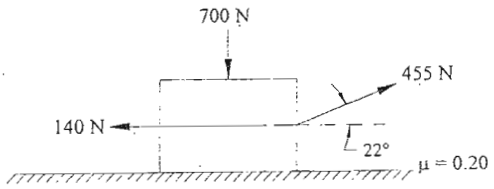


Fig. 2.

Turn over

8. Find the mass moment of inertia of the slender rod shown in Fig. 3 with respect to the z-axis.

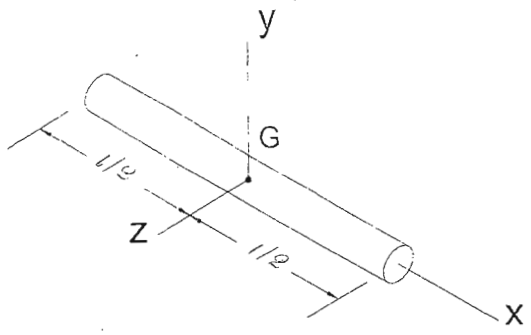


Fig. 3.

9. A bomb is released from an aeroplane, flying at a speed of 1500 km/hr on a straight line, 2000 m. above the ground. Determine the time required for the bomb to reach the ground and the horizontal distance travelled by the bomb.

10. A car of mass 300 kg is travelling at 36 km/hr on a level road. It is brought to rest, after travelling a distance of 5 m. What is the average force of resistance acting on the car ?

11. A flywheel starts rotating from rest and is given an acceleration of 2 rad/sec^2. (i) Find the angular velocity and speed in r.p.m. after 60 sec. (ii) If the flywheel is brought to rest with a uniform angular retardation of 1.25 rad/sec^2, determine the time taken by the flywheel in seconds to come to rest.

(4 × 5 = 20 marks)

Part C

Answer section (a) **or** *section (b) of each question.*

12 (a) A small ring B carries a vertical load P and is supported by two strings BA and BC, the latter of which carries at its free end a weight Q = 10 N, as shown in Fig. 4. Find the magnitude of the load P and the tension S in the string AB, if the angles that the strings AB and BC make with the vertical are as shown in the figure and the system is in equilibrium.

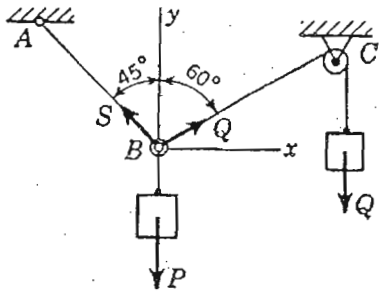


Fig. 4.

Or

(b) Two vertical masts AB and CD are guyed by the wires BF and DG, in the same vertical plane and connected by a cable BD of length l = 20 m, from the middle point E of which is suspended a load Q of 100 N as shown in Fig. 5. Find the tensile force S in each of the two guy wires BF and DG if the sag d =1 m.

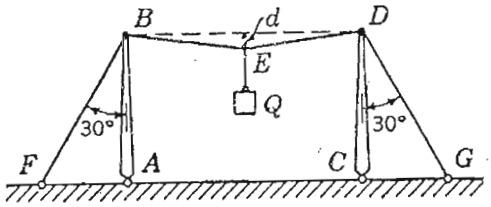


Fig. 5.

13. (a) Find the forces in members EC, DC and DH for the truss shown in Fig. 6.

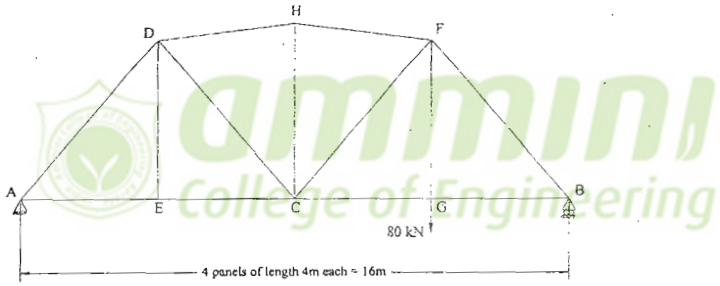
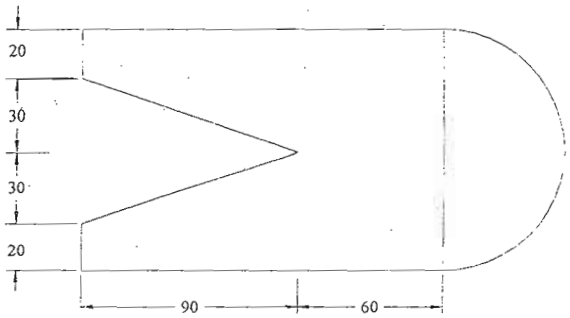


Fig. 6.

Or

(b) Calculate the moment of inertia of the section shown in Fig. 7 about the centroidal axes.



All dimensions are in mm

Fig. 7.

14. (a) Two weights P (40 N) and Q (30 N) are connected in arrangement as shown in Fig. 8. in next page. Neglecting friction and the inertia of the pulleys and cord, find the acceleration a of the weight Q. Assume that P= 40 N and Q= 30 N.

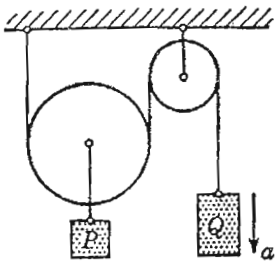


Fig. 8.

Or

(b) A projectile is aimed at a mark on the horizontal plane through the point of projection and falls 12 m. short when the angle of projection is 15°. When it is tried again it over shoots the mark by 24 m. with the angle of projection as 45°. Find the correct angle of projection to hit the mark.

15. (a) A wheel is attached to the shaft of an electric motor of rated speed of 2000 r.p.m. When the power is switched on, the unit attains the rated speed in 10 seconds and when the power is switched off, the unit comes to rest in 100 seconds. Assume uniformly accelerated motion and determine (i) the number of revolutions the unit turns to attain the rated speed ; and (ii) to come to rest.

Or

(b) An elevator system is modelled as m_1 = 2000 kg, m_2 = 1 800 kg and a uniform disk of m_3 = 200 kg as shown in Fig. 9. Calculate the velocity of m_1 at time t = 10 sec after the system starts from rest.

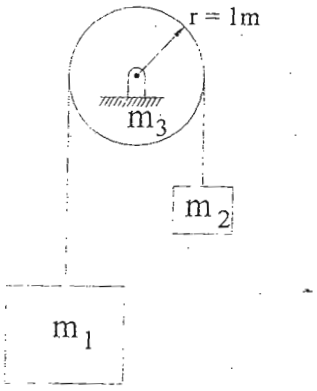


Fig. 9.

(4 × 10 = 40 marks)