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BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) B.Tech. (AEROSPACE ENGINEERING)

Term-End Examination

June, 2011

BME-016 : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any five** questions. Use of calculator is **permitted**.*

1. (a) The following forces act at a point : **7+7**

(i) 20 N inclined at 30° towards North of east

(ii) 25 N towards North

(iii) 30 N towards North west, and

(iv) 35 N inclined at 40° towards South of west

Find the magnitude and direction of the resultant force.

(b) An electric light fixture weighing 15 N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60° to the horizontal at BC at 45° to the horizontal as shown in Fig.1.

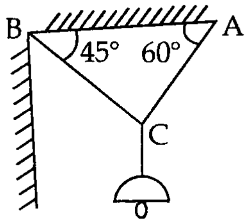


Fig. 1

Determine the tension in each string.

2. (a) A semi circular area is removed from a trapezium as shown in Fig. 2. Determine the centroid of remaining area. 7+7

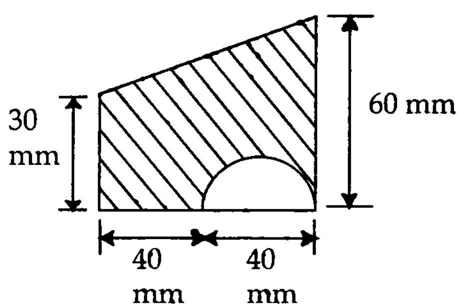


Fig. 2

(b) Find the moment of inertia of a T section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm about X–X and Y–Y axis through the centroid of the section as in Fig. 3.

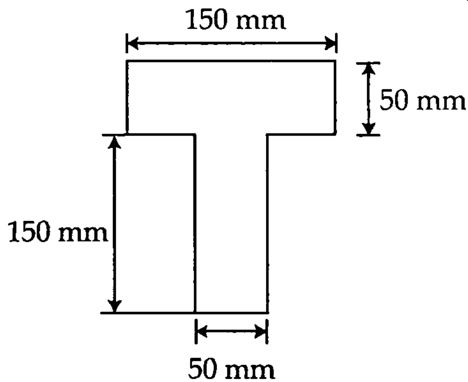


Fig. 3

3. (a) A truss shown in Fig. 4 is carrying a point load of 5 kN at E. Find the forces in members CE, CD and BD of the truss. 7+7

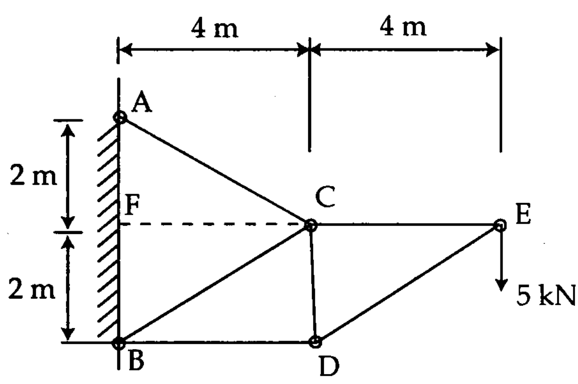


Fig. 4

(b) A truss of 12 m span is loaded as shown in Fig. 5. Determine the forces in the members BD, CE and CD of the truss.

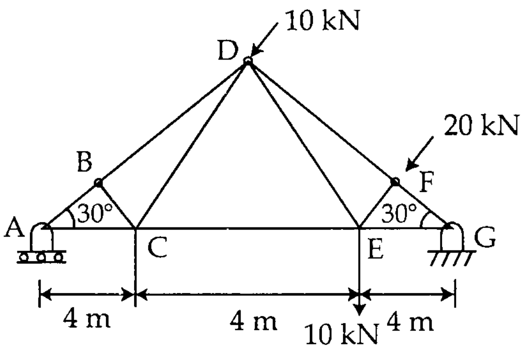


Fig. 5

4. (a) A stone is dropped from the top of a tower 50 m high. At the same time another stone is thrown upwards from the foot of the tower with a velocity of 25 m/s. Where and when the two stones cross each other ? **7+7**

(b) A particle is thrown with a velocity of 5 m/s at an elevation of 60° to the horizontal. Find the velocity of another particle thrown at an elevation of 45° which will have (a) equal horizontal range (b) equal max height, and (c) equal time of flight.

5. (a) A fly wheel is making 180 rpm and after 20 sec it is running at 120 rpm. How many revolutions will it make and what time will elapse before it stops, if the reaction is uniform ? **7+7**

(b) Two bodies A and B of mass 80 kg and 20 kg are connected by a thread and move along a rough horizontal plane under the action of a force 400 N applied to the first body of mass 80 kg as shown in Fig. 6. If $\mu = 0.3$, determine the acceleration of the two bodies and tension in thread.

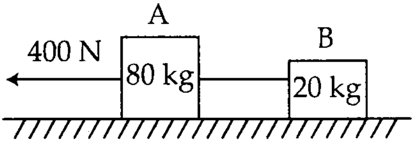


Fig. 6

6. (a) Two smooth inclined planes whose inclinations with the horizontal are 30° and 20° are placed back to back. Two bodies of mass 10 kg and 6 kg are placed on them and are connected by a light in extensible string passing over a smooth pulley as shown in Fig. 7. Find the tension in the string. Take $g = 9.8 \text{ m/s}^2$. 7+7

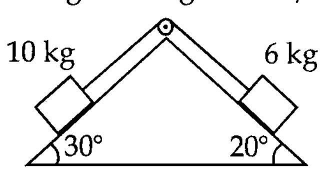


Fig. 7

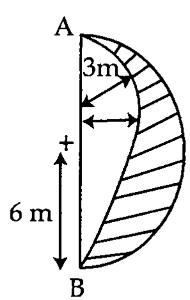
(b) A truck of mass 15 tonnes travelling at 1.6 m/s impacts with a buffer spring, which compresses 1.25 mm per kN. Find the max. Compression of the spring.

7. (a) Two bodies A and B of masses 800 kg and 600 kg are attached at the ends of a flexible rope. The rope passes over a pulley of 800 mm diameter. The pulley has a mass 100 kg with a radius of gyration as 400 mm about it's axis of rotation. Find its torque which must be applied to its pulley to raise the 800 kg body with an acceleration of 1 m/s^2. Neglect friction of spindle. **7+7**

(b) A ball of mass 1 kg moving with a velocity of 2 m/s impinges directly on a ball of mass 2 kg at rest. The first ball, after impinging, come to rest. Find its velocity of the second ball after impact and coefficient of restitution.

8. (a) Explain perpendicular axis theorem and parallel axis theorem. **6+8**

(b) Determine the angle that its line AB makes with the vertical when its shaded area is suspended at A.



9. (a) In a differential Screw Jack, the screw threads have pitch of 10 mm and 7 mm. If the efficiency of screw jack is 28%, find the effort required at thread of an arm 360 mm long to lift a load of 5 kN. **7+7**

(b) Find the force required to move a load of 300 N up a rough plane, the force being applied parallel to the plane. The inclination of the plane is such that when the same load is kept on a perfects smooth plane inclined at the same angle, a force of 60 N is applied at an inclination of 30° to the plane, keeps the same load in equilibrium. Assume $\mu = 0.3$.
