B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering)

01716

Term-End Examination

June, 2010

ET-202(A) : ENGINEERING MECHANICS

Time : 3 hours   *Maximum Marks : 70*

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

1. (a) A lamp weighing 5 N is suspended from the ceiling by a chain. It is pulled aside by a horizontal cord until the chain makes an angle of 60° with the ceiling as shown in figure-1. Find the tensions in the chain and the cord.   5+5
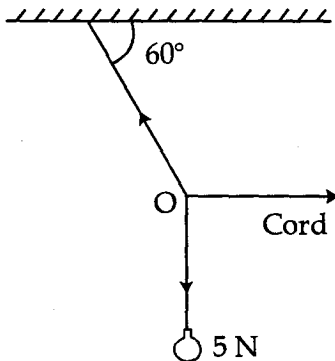

Figure - 1

(b)   The resultant of four forces which are acting at a point O as shown in figure-2 is along Y-axis. The magnitude of forces F_1, F_3 and F_4 are 10 kN, 20 kN and 40 kN respectively. The angles made by 10 kN, 20 kN and 40 kN with X-axis are 30°, 90° and 120° respectively. Find the magnitude and direction of force F_2. if resultant is 72 kN.
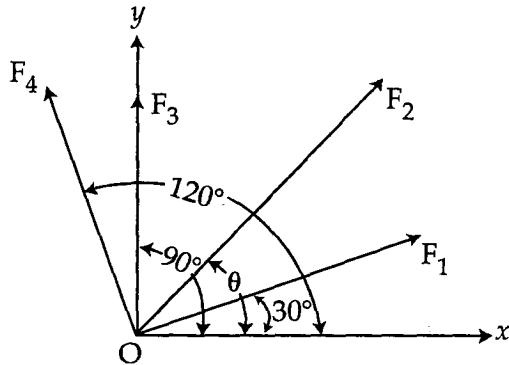

Figure - 2

2.   (a)   Four parallel forces of magnitudes 100 N, 150 N, 25 N and 200 N are shown in figure -3. Determine the magnitude of the resultant and also the distance of the resultant from point A.
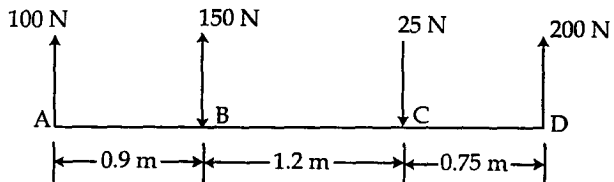
5+5

Figure - 3

(b) Three parallel forces F_1, F_2, and F_3 are acting on a body as shown in figure-4, and the body is in equilibrium. If force $F_1 = 250$ N, and $F_3 = 1000$ N and the distance between F_1 and $F_2 = 1.0$ m, then determine the magnitude of force F_2 and the distance of F_2 from force F_3
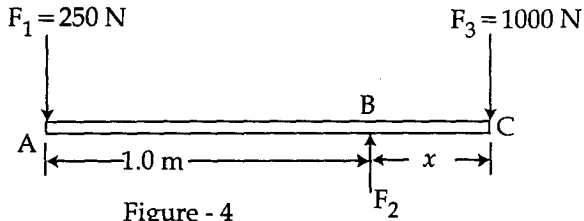
$F_1 = 250$ N $\qquad\qquad\qquad\qquad$ $F_3 = 1000$ N

B

A $\quad$ C

|←——1.0 m——→|←— x —→|

Figure - 4 $\qquad$ F_2

3. (a) A circular roller of 1000 N and radius $\quad$ 5+5
20 cm hangs by a tie rod AB = 40 cm and rests against a smooth vertical wall at C as shown in figure-5. Determine the tension in the tie rod and reaction R_c at point C.
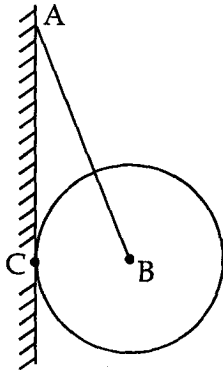
A

C $\quad$ •B

Figure - 5

(b) A simply supported beam of length 10 m, carries the uniformly distributed load and two point loads as shown in figure-6. Calculate the reactions R_A and R_B.
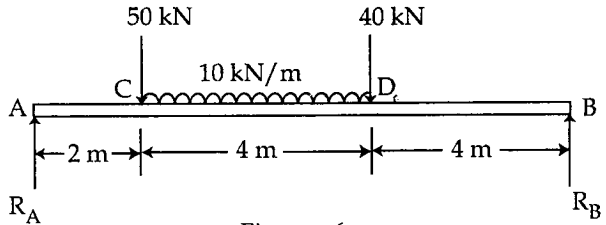

Figure - 6

4. (a) Determine the forces in the truss shown in figure-7 which carries a horizontal load of 12 kN and a vertical load of 18 kN.
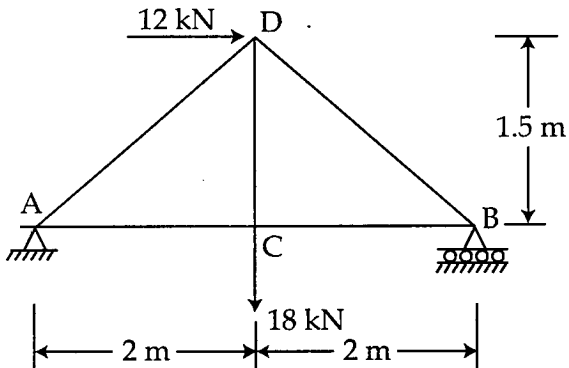
5+5

Figure - 7

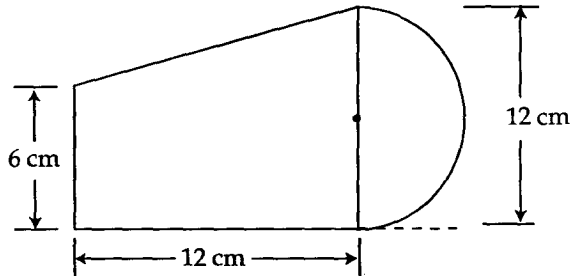(b)   Determine the centroid of the area as shown in figure-8.

Figure - 8

5.   (a)   Find the moment of inertia of the section 5+5
shown in figure-9 about the centroidal axis
X - X perpendicular to the web.
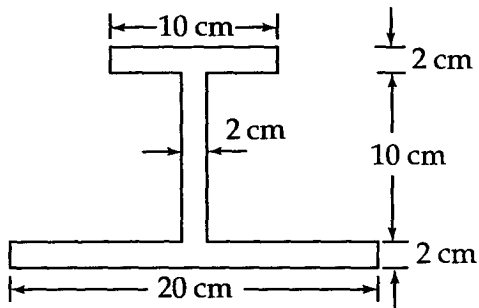

Figure - 9

(b)   A body of weight 500 N is pulled up an
inclined plane, by a force of 350 N.
The inclination of the plane is 30° to the
horizontal and the force is applied parallel
to the plane. Determine the co-efficient of
friction.

6. (a) Refering to the figure-10, determine the least **5+5** value of the force P to cause motion to impend rightwards. Assume the co-efficent of friction under the blocks to be 0.2 and pulley to be frictionless.
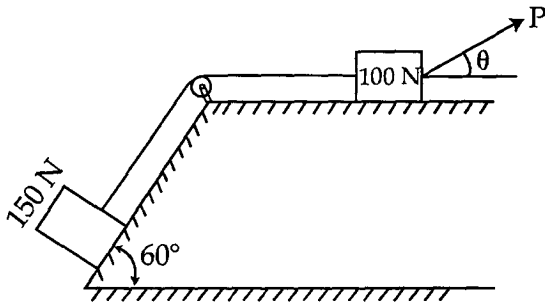

Figure - 10

(b) The equation of motion of a particle moving in a straight line is given by

$$s = 15\,t + 3\,t^2 - t^3$$

where s is the distance covered from the starting point in metre at the end of t seconds.

Find :

(i) the velocity and acceleration at the start.

(ii) the time, when the particle reaches its maximum velocity, and

(iii) the maximum velocity of the particle.

7. (a) A body falling freely under the action of **5+5** gravity passes two points 10 m apart vertically in 0.2 seconds. From what height, above the higher point, did the body start to fall ? Take $g = 9.8$ ms^{-2}.

(b) The angle of rotation of a body is given by the equation :

$\theta = t^3 - 4t^2 + 10t + 5$

where θ is expressed in radians and t in seconds.

Determine :

(i) Angular velocity and

(ii) angular acceleration of the body when $t = 0$ and $t = 5$ seconds.

8. (a) An aircraft moving horizontally at a speed of 360 kmph at a height of 490 m toward a target on the ground, releases a bomb which hits the target. **5+5**

Find :

(i) time required for the bomb to reach the target on the ground, and

(ii) the horizontal distance of the air-craft from the target when it released the bomb.

(b) Two blocks as shown in figure 11, have weights $A = 20N$ and $B = 10N$ and co-efficient of friction between the block A and the horizontal plane is $\mu = 0.25$. If the system is released from the rest and the block B falls through a vertical distance of 2 m, what is the velocity attained by block B ? Neglect the friction in the pulley and the extension of the string.
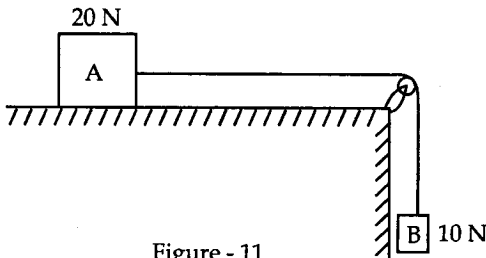
20 N

A

Figure - 11

B 10 N

9. (a) A body is moving with simple harmonic 5+5 motion and has velocities of 9 m/s and 4 m/s at a distance of 1m and 2.5m respectively from the mean position. Find the amplitude and time period of the body.

(b) A vehicle of mass 600 kg and moving with a velocity of 12 m/s strikes another vehicle of mass 400 kg moving at 9 m/s in the same direction. Due to the impact both the vehicles get coupled and move together. Find the common velocity with which the two vehicles move after impact.

10. A beam of length 12 m is simply supported at two   10 supports which are 8 m apart, with an overhang of 2 m on each side as shown in figure 12. The beam carries a concentrated load of 1000 N at each end. Draw SF and BM diagrams.
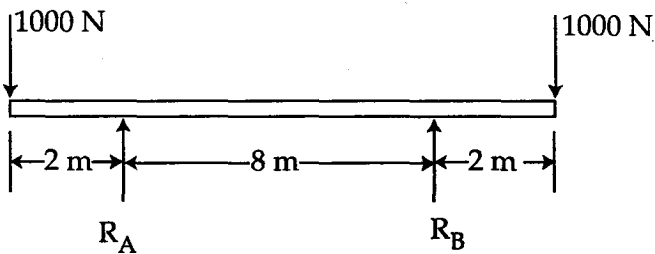

Figure - 12