May - Jun - 2011

[3961] – 113

F.E. (Semester – II) Examination, 2011
ENGINEERING MECHANICS
(For Students Admitted during the Academic Year 2008-2009)
(2008 Pattern)

Time : 3 Hours Max. Marks : 100

Instructions: *1) Attempt Q. 1 or Q. 2, Q. 3 or Q. 4 and Q. 5 or Q. 6 from Section – I and Q. 7 or Q. 8, Q. 9 or Q. 10, Q. 11 or Q. 12 from Section – II.*

*2) Answer to the **two** Sections should be written in **separate** answer books.*

*3) Neat diagrams must be drawn **wherever** necessary.*

*4) Figure to the **right** indicates **full** marks.*

*5) Assume suitable data, **if** necessary and **clearly** state.*

*6) **Use** of cell phone is **prohibited** in the Examination hall.*

*7) **Use** of electronic pocket calculator is **allowed**.*

SECTION – I

1. a) Two forces are shown in Fig. 1 (a). Knowing that the magnitude of P is 600 N, determine

   a) The required angle θ if the resultant R of the two forces is to be vertical.

   b) The corresponding value of R. **8**

   b) Determine the position of centroid of the shaded area as shown in Fig. 1 (b) with respect to origin O. **8**

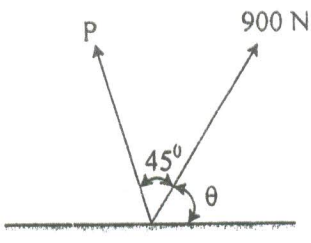

Fig. 1 a

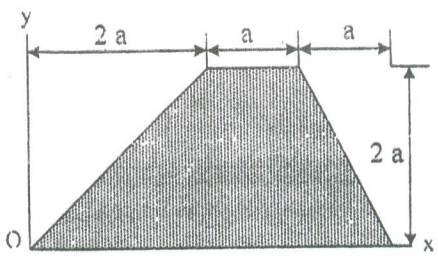

Fig. 1 b

OR

2. a) Knowing that the tension in cable BC is 145 N, determine the resultant of the three forces exerted at point B of beam AB. Refer Fig. 2 (a). **8**

b) Two 24 mm diameter pegs are mounted on a steel plate at A and C, and two rods are attached to the plate at B and D. A cord is passed around the pegs and pulled as shown in Fig. 2 (b). The rods exert a force of 2.5 N on the plate. Determine

a) The resulting couple acting on the plate when T = 9 N

b) If only cord is used, in what direction should it be pulled to create same couple with the minimum tension in the cord, and

c) Magnitude of minimum tension. **8**

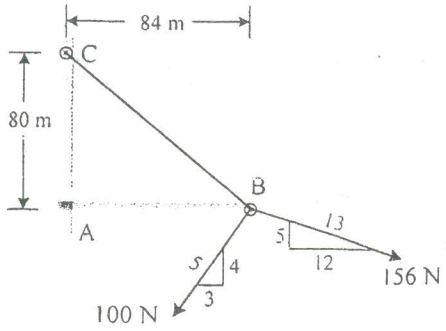

Fig. 2 a

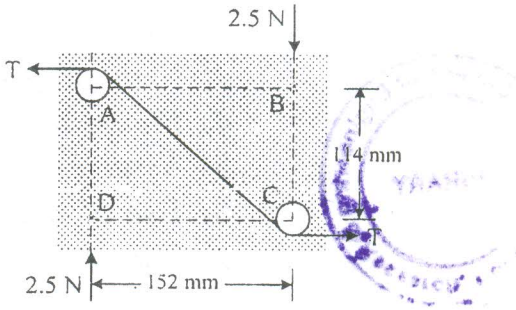

Fig. 2 b

3. a) For the given loading of the beam AB, determine the range of values of the mass of the crate for which the system will be in equilibrium, knowing that the maximum allowable value of the reactions at each support is 2.5 kN and the reaction at E must be directed downward. Refer Fig. 3 (a). **8**

b) A tripod support a load of 30 kg as shown in Fig. 3 (b). Determine the forces in the legs of the tripod, if the length of each leg is 5 m and the distance between any two legs at the base in horizontal plane is 3 m. **8**

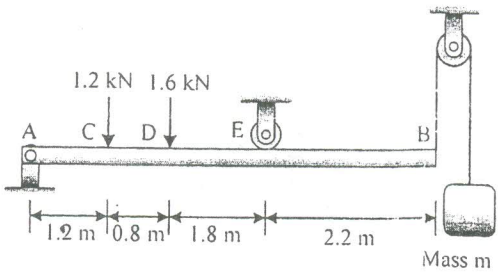

Fig. 3 a

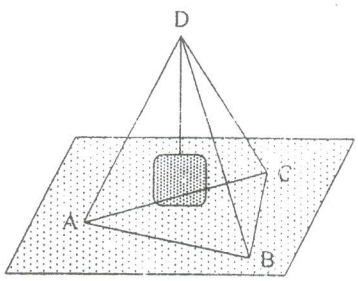

Fig. 3 b

OR

4. a) Determine the magnitude of the resultant and its location with respect to origin O as shown in Fig. 4 (a). **8**

   b) The L-shaped member ACB is supported by a pin support at C and by an inextensible cord attached at A and B and passing over a frictionless pulley at D.

   Determine the tension in the cord and the reaction at C. Refer Fig. 4 (b). **8**

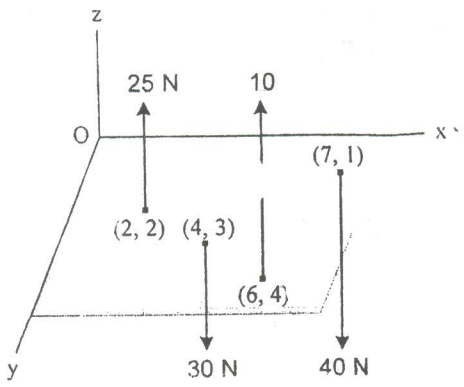

Fig. 4 a

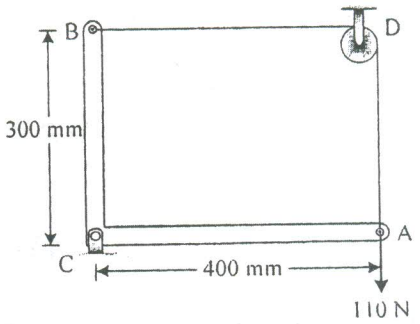

Fig. 4 b

5. a) Indentify zero force members and find magnitude and nature of forces in remaining members of the truss as shown in Fig. 5 (a). **9**

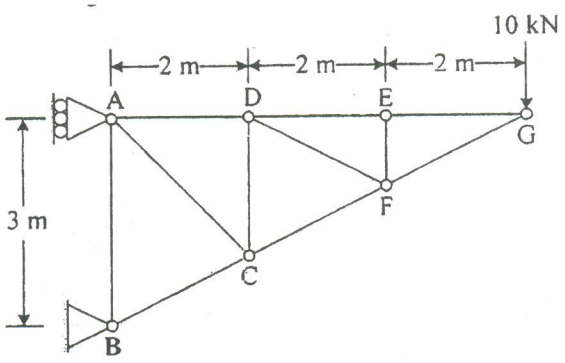

Fig. 5 a

b) A cable passes around three 0.05 m radius pulleys and supports two blocks as shown in Fig. 5 (b). Pulleys C and E are locked to prevent rotation and the coefficient of friction between the cable and pulleys are $\mu_s = 0.2$. Determine the range of values of the weight of block A for which equilibrium is maintained, if the pulley D is free to rotate. **9**

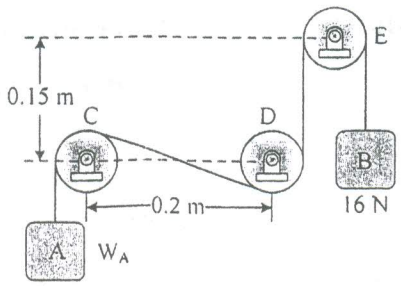

Fig. 5 b

OR

6. a) Cable ABC supports two boxes as shown in Fig. 6 (a). Knowing that b = 2.7 m, determine the required magnitude of the horizontal force P and the corresponding distance a. **9**

b) Determine whether the block shown in Fig. 6 (b), is in equilibrium, and find the magnitude and direction of the friction force when θ=30° and P = 200 N. **9**

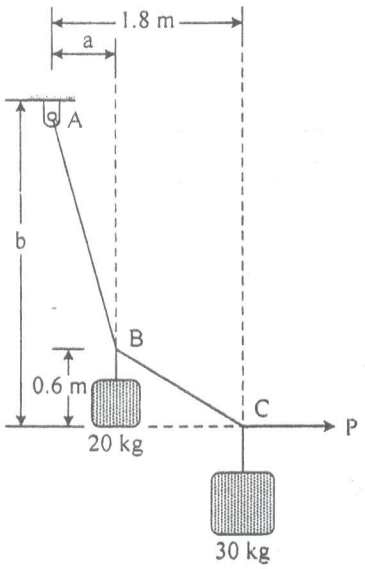

Fig. 6 a

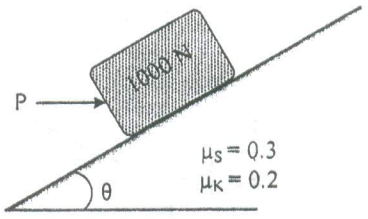

Fig. 6 b

SECTION – II

7. a) A baseball is thrown downward from a 15 m tower with an initial speed of 5 m/s. Determine the speed at which it hits the ground and the time of travel. **8**

   b) The conveyor belt is designed to transport packages of various weights. Each 10 kg package has a coefficient of kinetic friction $\mu_k = 0.15$. If the speed of the conveyor is 5 m/s, and then it suddenly stop, determine the distance the package will slide on the belt before coming to rest.
   Refer Fig. 7 b. **10**

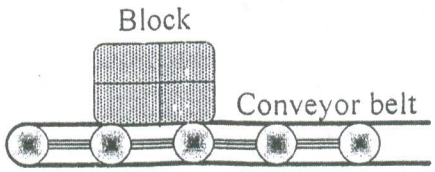

Fig. 7 b

OR

8. a) The velocity of a particle moving along x-axis is defined by $v = k\,x^3 - 4x^2 + 6x$ where v is in m/s, x is in meter and k is constant. If k = 1, determine the value of acceleration when x = 2 m. **8**

   b) A small block starts from rest at point A and slides down the inclined plane BC as shown in Fig. 8 (b). What distances along the horizontal plane BC will it travel before coming to rest. The coefficient of kinetic friction between the block and the plane is 0.3. Assuming that the initial velocity with which it starts to move along BC is of the same magnitude as that gained in sliding from A to B. **10**

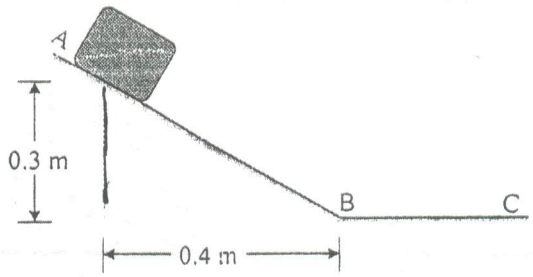

Fig. 8 b

9. a) A particle position is describe by the coordinates r = (2 sin 2θ) m and θ = (4t) rad, where t is in seconds. Determine the radial and transverse components of its velocity and acceleration when t = 1 s. **8**

b) Determine the maximum constant speed at which the pilot can travel around the vertical curve having a radius of curvature ρ=800 m, so that he experiences a maximum acceleration a_n = 8 g = 78.5 m/s^2. If he has a mass of 70 kg, determine the normal force he exerts on the seat of the airplane when the plane is traveling at this speed and is at the lowest point. Refer Fig. 9 (b). **8**

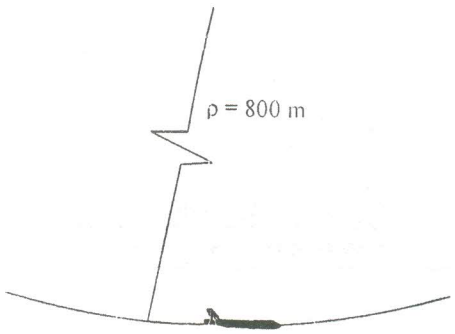

Fig. 9 b

OR

10. a) A golfer hits the golf ball from point A with an initial velocity of 50 m/s at an angle of 25° with the horizontal as shown in Fig. 10 (a). Determine the radius of curvature of the trajectory described by the ball

a) at point A b) at the highest point of the trajectory. **8**

b) The collar has a weight of 25 N and the attached spring has an unstretched length of 1 m. If the collar is positioned on the rod so that θ=30° and released from rest, determine the initial acceleration of the collar and the normal force on it. Neglect friction. Refer Fig. 10 (b). **8**

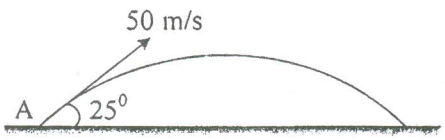

Fig. 10 a

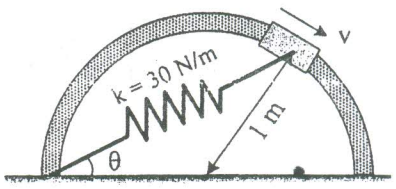

Fig. 10 b

11. a) Blocks A and B have masses of 40 kg and 60 kg respectively. They are placed on a smooth surface and the spring connected between them is stretched 2 m. If they are released from rest, determine the speeds of both blocks the instant the spring becomes unstretched, by work energy method. Refer Fig. 11 (a). **8**

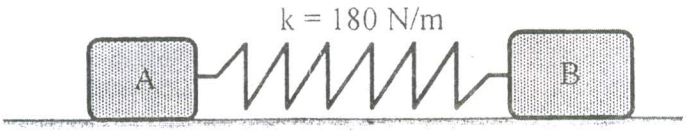

Fig. 11 a

b) A jet plane has a mass of 250 Mg and a horizontal velocity of 100 m/s when t = 0. If the engines provide a resultant horizontal thrust F = (40 + 0.5 t) kN, where t is in seconds. Using impulse-momentum principle determine the time needed for the plane to attain a velocity of 200 m/s. Neglect air resistance and the loss of fuel during the motion. **8**

OR

12. a) The identical 1.2 kg collars A and B are sliding as shown in Fig. 12 (a) on a frictionless rod. Knowing that the coefficient of restitution is e = 0.65, determine

    a) The velocity of each collar after impact,

    b) The energy lost during friction. **8**

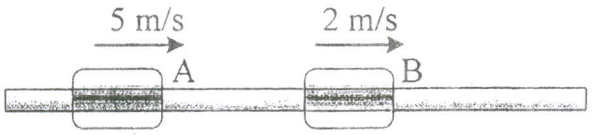

Fig. 12 a

b) Define conservative and non conservative forces with example. Also derive an expression of work-energy principle from Newton's second law of motion. **8**
