Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech
BE 2104

Second Semester Regular Examination – 2014

MECHANICS

BRANCH(S) : ALL

QUESTION CODE : F 465

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) What are the conditions to be satisfied for the equilibrium of rigid bodies in two dimensions ?

(b) A force of 100 kN acts at an angle of 45° as shown in the Figure 1 below. Determine the moment of this force about point O.

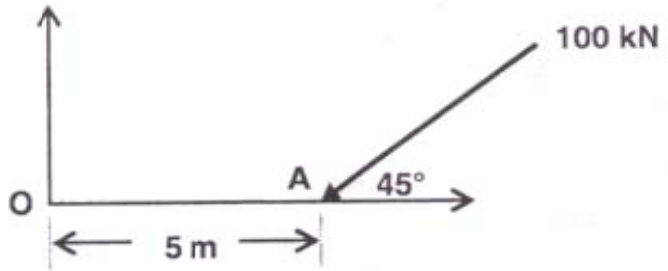

Figure 1

(c) A square ABCD has sides equal of 200 mm. Forces of 150 N each act along AB and CD and 250 N act along CB and AD. Find the moment of the couple, which will keep the system in equilibrium.

(d) Find the force required to drag a body (of mass 100 kg) up along the plane on which it rests. The plane makes an angle of 20° with the horizontal. Contact planes have coefficient of friction 0.25.

P.T.O.

(e) Differentiate between center of volume and centre of mass. What is centroid ?

(f) Explain the application of the principle of virtual work in case of lifting machines.

(g) A body of mass 10 Kg is moving with a velocity of 1 m/sec. If a force of 10 N is applied on the body, determine its velocity after 3 seconds.

(h) Write the differential equation for forced vibrations.

(i) Explain the terms :

(i) Coefficient of restitution and

(ii) Semi-elastic impact

(j) A body is projected at such an angle that the horizontal range is three times the greatest height. Find the angle of projection.

2. (a) A 80 Kg man stands on the middle rung (at D) of a ladder AB of weight 30 Kg, which is supported on smooth wall and smooth floor. A horizontal string CD holds the ladder in position preventing it from slipping **(Fig: 2)**. Determine the tension in the string and the reaction at the supports. AC=4 m. 5

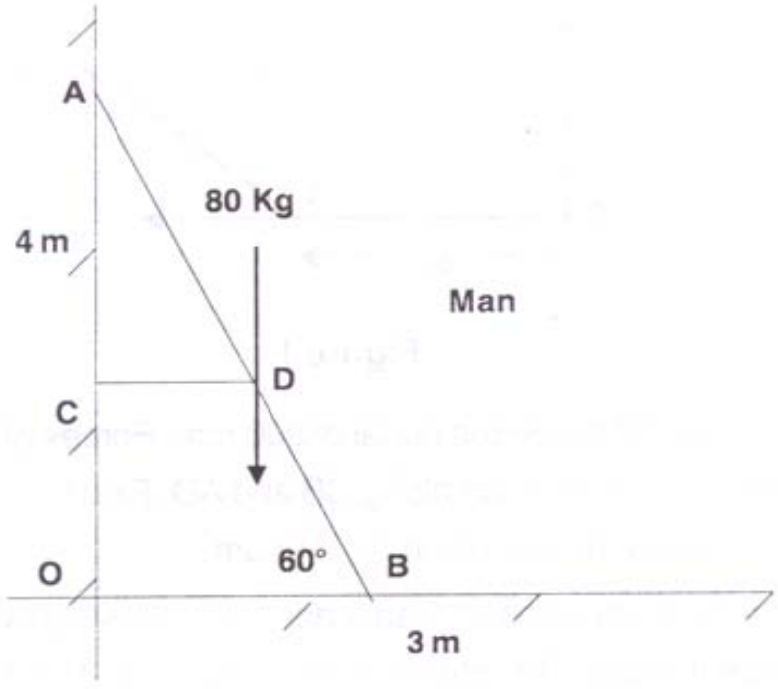

Figure 2

(b) A simply supported beam AB of span 6 m is hinged at A and roller supported at B. It carries a uniformly varying load over the entire span whose intensity varies from 10 N/m at A to 50 N/m at B. Determine the reactions at the supports. 5

3. A pin jointed simply supported truss ABC is hinged at A and supported on a roller at C. It is loaded as shown in **Fig. 3**. AB = BC = CA = 6 m. D, E and F are mid points of AC, BC and AB. Find the forces in the members of the truss. 10

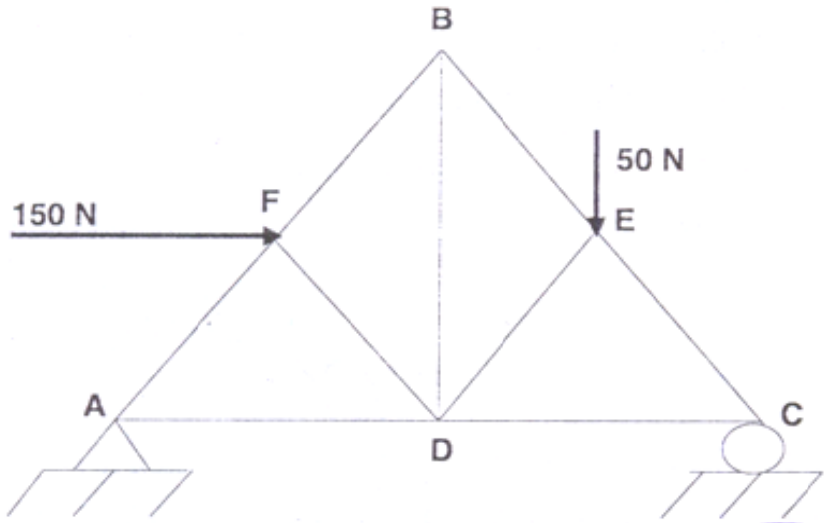

Figure 3

4. (a) A body of weight 1 kN is kept in position on a plane inclined 30° to the horizontal by a horizontally applied force (F). If the coefficient of friction of the surface of the inclined plane is 0.3, determine the minimum magnitude of the force (F). 5

(b) Determine the centroid of the area enclosed between the straight line $y = x$ and the curve $y = x^2/3$. 5

5. (a) Determine the moment of inertia about the centroidal x- and y-axis of the area of an inverted T section with flange 50 mm × 10 mm and web 100 mm × 10 mm. 5

(b) A simply supported bean AB of span 7 meters is carrying a load of 3 kN at a distance of 3 m from A and a clockwise moment of 50 kNm at mid- span. Determine the support reactions using the method of virtual work. Neglect the weight of the beam. 5

6. (a) A ball is fired with a velocity of 45 m/sec from a point 20 meters in front of a vertical wall 7.5 meters high. Find the angle of projection, to the horizontal for the shot just to clear the top of the wall. 5

(b) A train moving with a velocity of 40 kmph has to slow down to 20 kmph due to repairs along the road. If the distance covered during retardation is 2 km and that covered during acceleration be 1 km, find the time lost in the journey. 5

7. (a) Find the amplitude and time period of a particle moving with simple harmonic motion, which has a velocity of 9 m/sec and 4 m/sec at the distance of 2 m and 3 m respectively from the center. 5

(b) A wheel that can rotate freely about an axle, but cannot move in any other way. It is initially spinning at a rate of $\omega = 30$ rad/sec but the friction at the axle produces a torque $T = 15$ Nm about the axle. How long does it take the wheel to come to a stop ? Mass of the wheel is 5 Kg and radius of gyration is 1 m. 5

8. (a) A hammer of mass 0.6 kg hits a nail of 20 grams with a velocity of 5 m/sec and drives it into a fixed wooden block by 30 mm. Find the resistance offered by wooden block. 5

(b) A locomotive draws a train of mass 500 tonnes, (including its own mass) on a level ground with a uniform acceleration, until it acquires a velocity of 60 kmph in 5 minutes. If the frictional resistance is 50 Newtons per tone of mass and the air resistance varies with the square of the velocity, find the power of the engine. Take air resistance as 600 Newtons at 20 kmph. 5
