COLLEGE OF ENGINEERING PUNE
End-Sem- 2011-2012 (I SEM)
Engineering Mechanics CE 101

Programme: F. Y. B. Tech. Date: 24-11-2011
Duration: 180 Minutes Max. Marks: 100
Time: 10-00 am to 1-00 pm

Instructions :
1. **Answer all questions.**
2. **Figures to the right indicate full marks.**
3. **Use of non-programmable calculator is allowed.**
4. **Assume suitable data if required.**

Q.1a Determine the polar moment of inertia of the area shown in Fig. 1 with respect to (a) point O, (b) the centroid of the area. (10)

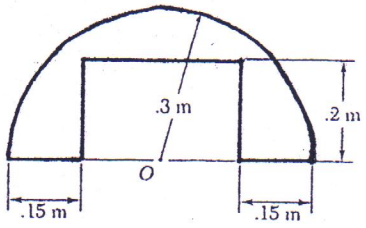

Fig. 1

Q. 1b Determine the force in each member of the truss shown in Fig. 2. State whether each member is in tension or compression. (8)

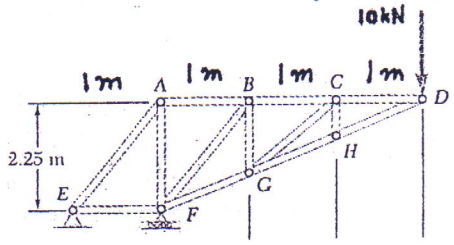

Fig. 2

Q. 2a A 120-kg block is supported by a rope which is wrapped $1\frac{1}{2}$ times around horizontal rod as shown in Fig. 3. Knowing that the coefficient of static friction between the rope and the rod is 0.15, determine the range of values of P for which equilibrium is maintained. (8)

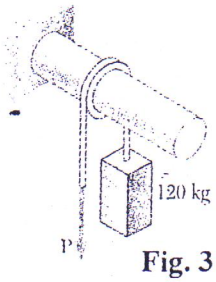

Fig. 3

Q.2 b From measurements of a photograph, it has been found that as the stream of water shown in Fig. 4, left the nozzle at A, it had a radius of curvature of 25 m. Determine (a) the initial velocity v_A of the stream, (b) the radius of curvature of the stream as it reaches its maximum height at B. (8)

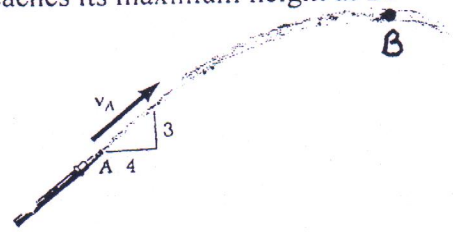

Fig. 4

Q. 3a The motion of a 1.8 kg block B shown in Fig. 5, in a horizontal plane is defined by the relations $r = 3t^2 - t^3$ and $\theta = 2t^2$, where r is expressed in meter, t in seconds, and θ in radians. Determine the radial and transverse components of the force exerted on the block when (a) t = 0, (b) t = 1 s. (8)

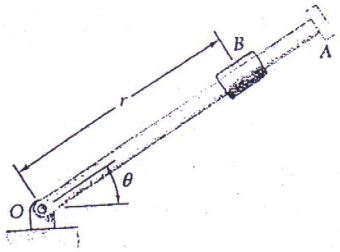

Fig. 5

Q. 3b Two 400 mm rods AB and DE are connected as shown in Fig. 6. Point D is the midpoint of rod AB, and at the instant shown rod DE is horizontal. Knowing that the velocity of point A is 240 mm/s downward, determine (a) the angular velocity of rod DE, (b) the velocity of point E. (8)

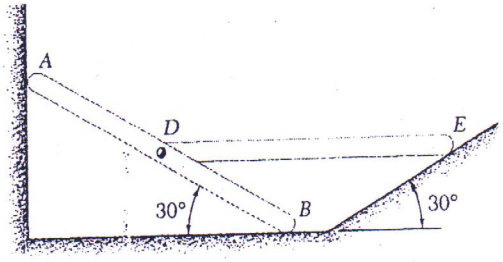

Fig. 6

Q. 4a Packages in an automobile parts supply house are transported to the loading deck by pushing them along on a roller track with very little friction. At the instant shown in Fig. 7, packages B and C are at rest and package A has a (8)

velocity of 2 m/s. knowing that the coefficient of restitution between the packages is 0.3, determine (a) the velocity of package C after A hits B and B hits C, (b) the velocity of A after it hits B for the second time.

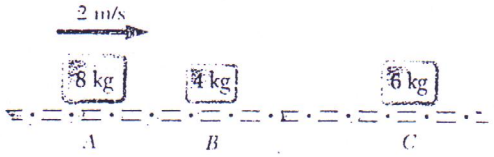

Fig. 7

Q. 4b A 2-kg ball revolves in a horizontal circle as shown in Fig. 8 at a constant speed of 1.5 m/s. Knowing that L = 600 mm, determine (a) the angle θ that the cord forms with the vertical, (b) the tension in the cord. (8)

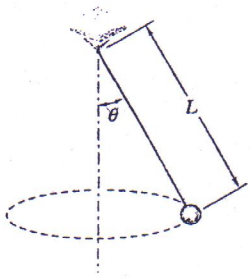

Fig. 8

Q. 5a The subway train shown in Fig. 9 is travelling at a speed of 5 km/h when the brakes are fully applied on the wheels of cars B and C, causing them to slide on the track, but are not applied on the wheels of car A. Knowing that the coefficient of kinetic friction is 0.35 between the wheels and the track, determine (a) the distance required to bring the train to stop, (b) the force in each coupling. (8)

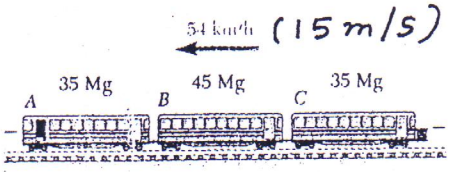

Fig. 9

Q. 5b A 4-kg collar A shown in Fig. 10 can slide without friction along vertical rod and is released from rest in the position shown with the springs undeformed. Knowing that the constant of each spring is 300 N/m, determine the velocity of the collar after it has moved (a) 100 mm, (b) 190 mm. (8)

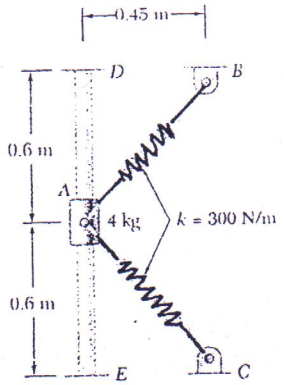

Fig. 10

Q. 6a Derive the governing equation of motion for forced vibration case with damping and solve it for only for the case of free vibration without damping. (10)

Q. 6b A 25 kg block is supported by the spring arrangement shown in Fig. 11. If the block is moved vertically downwards from its equilibrium position and released, determine (a) the period and frequency of the resulting motion, (b) the maximum velocity and acceleration of the block if the amplitude of the motion is 30 mm. (8)

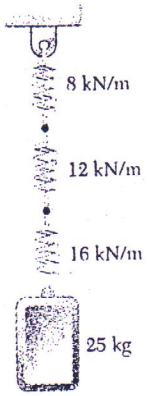

Fig. 11