Bengal Engineering and Science University, Shibpur
Department of Aerospace Engineering and Applied Mechanics
B. E. (Mech./Aero) Part-II 3rd Semester Examination, November 2013

Engineering Dynamics (AM 311)

Time: 3 Hours Full Marks: 70

Answer any three from each half
All questions are of equal value
Two marks in each half for neatness

FIRST HALF

1. a) The telephone-cable reel is rolled down the incline by the cable leading from the upper drum and wrapped around the inner hub of the reel. If the upper drum is turned at the constant rate $\omega_1 = 2$ rad/s, calculate the time required for the center of the reel to move 30 m along the incline. No slipping occurs. Fig. Q. 1 (a)

   b) Film passes through the guide rollers and is being wound onto the reel, which is turned at a constant angular velocity ω. Determine the tangential acceleration a of the film as it enters the rollers. The thickness of the film is t, and s is sufficiently large so that the change in the angle made by the film with the horizontal is negligible. Fig. Q. 1 (b)

2. The flexible band F is attached at E to the rotating sector and leads over the guide pulley. For the position shown when BD is perpendicular to OA determine angular velocity and angular acceleration of BD. Fig. Q. 2

3. The elements of a switching device are shown. If the vertical control rod has a downward velocity v of 0.9 m/s when $\theta = 60^0$ and if roller A is in continuous contact with the horizontal surface, determine the magnitude of the velocity of C for this instant. Fig. Q. 3

4. a) The slider A moves in the slot at the same time that the disk rotates about its center Q with an angular speed ω positive in the counterclockwise sense. Determine the x- and y- components of the absolute acceleration of A if, at the represented, $\omega = 5$ rad/s, $\omega = -10$ rad/s^2, x = 100 mm, x = 150 mm/s and x = 500 mm/s^2. Fig Q. 4 (a)

   b) Consider a straight level railroad track with a 50-Mg railroad car moving along it at a constant speed of 15 m/s. Determine the horizontal force R exerted by the rails on the car if the track were located hypothetically at a) the north pole and b) the equator oriented in a north south direction.

5. a) Show that for a system of particle both absolute and relative angular momenta with respect to the mass centre are identical.

   b) Show that for a rigid body the summation of moments of external forces about the mass center is equal to the product of mass moment of inertia about the mass center and the angular acceleration of the rigid body.

AM 311

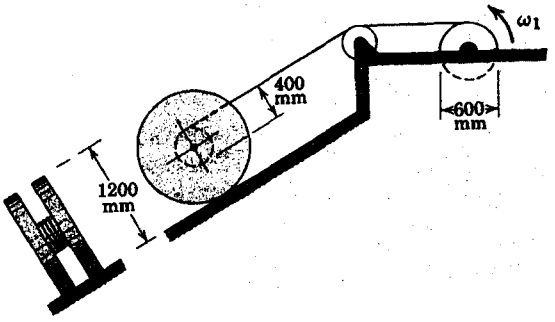

FIG. Q.1(a)

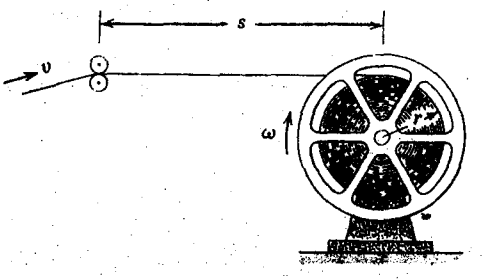

FIG. Q.1.(b)

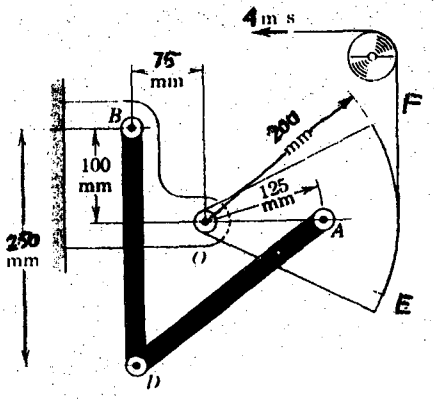

FIG. Q.2

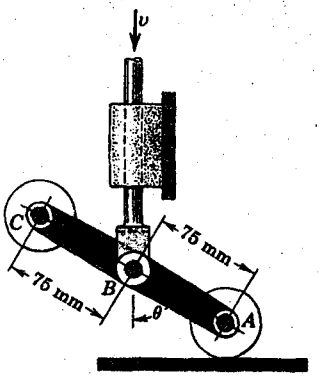

FIG. Q.3

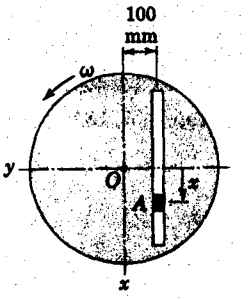

FIG. Q.4.(a)

Second Half

Answer any three questions

6. Referring to Fig. Q6, determine the equation for the envelope of the parabolic trajectories of a particle at a fixed velocity v but at any inclination. Neglect drag force of air and assume a constant value of gravitational acceleration.

7. In the quadratic crank mechanism as shown in Fig. Q7, determine the angular velocity of AD and the velocity of point D for the phase indicated. Assume $\omega_{BC} = 10$ rad/s.

8. A block of mass 25 kg is moving down with a velocity of 5.8 m/s, as shown in Fig. Q8. Mass moment of inertia of the drum is 18 Nms^2. If the drum rotates on frictionless bearings, determine the force P required to be applied at B to stop the drum within 2.5 s. Also determine the reaction at hinge A. Assume coefficient of friction between brake shoe and drum as 0.37.

9. Two wheels a and B of weight 100 kg and 55 kg respectively, initially 2.3 m apart are allowed to roll down an incline without slipping, as shown in Fig. Q9. The geometric radius and radius of gyration of wheels are $r_A = 0.16$ m, $i_A = 0.13$ m, $r_B = 0.09$ m, $i_B = 0.08$ m. Determine when and where the wheels will come in contact to each other, during rolling.

10. Referring to Fig. Q10, gear A having mass 5 kg and radius 0.15 m is at rest with the interconnected gear B with mass 12 kg and radius 0.3 m while a moment 6.7 Nm is applied on A. Determine the rotation number of gear A when its angular velocity reaches 631 rpm. Also determine the tangential force which gear A exerts on gear B. Consider $i_A = 0.1$ m and $i_B = 0.25$ m.

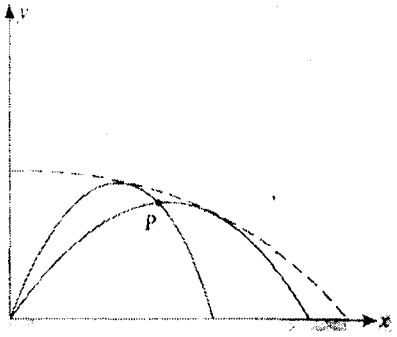

Fig. Q6

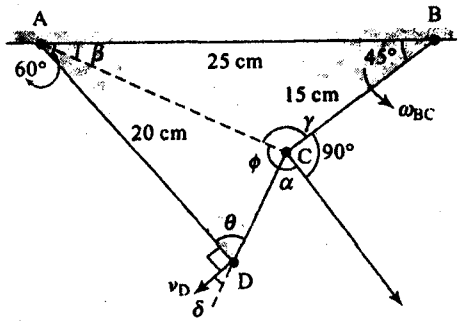

Fig. Q7

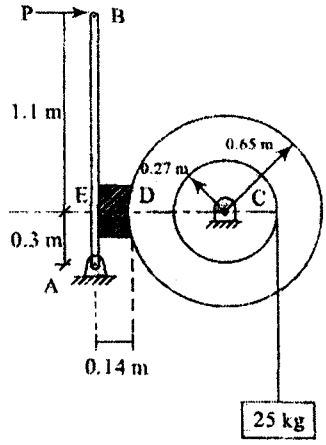

Fig. Q8

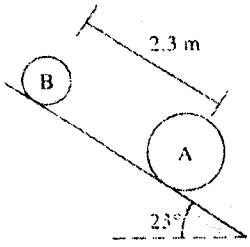

Fig. Q9

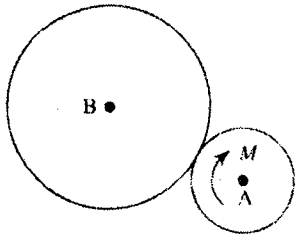

Fig. Q10