29/11/16

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR

B.TECH-M.TECH DUAL DEGREE 1st SEMESTER (CS, EE, ET, IT) EXAMINATION, 2016

MECHANICS (AM-1201) (AM1202)

FULL MARKS: 70 TIME: 3 Hrs

One marks is kept for neatness

Part A

(Answer any three Questions)

1. A uniform ring of mass m and radius r carries an eccentric mass m_0 at a radius b and is in an equilibrium position on the incline, which makes an angle α with the horizontal as shown in Fig. Q.1. If the contacting surfaces are rough enough to prevent slipping, write the expression for the angle θ which defines the equilibrium position. *12*
2. Determine magnitude and nature of forces in members BC and CG of the loaded truss shown in Fig. Q.2 . *12*
3. The special box wrench as shown in Fig. Q.3 with head B swiveled at C to the handle A will accommodate a range of sizes of hexagonal bolt heads. For the nominal size shown where the center O of the bolt and the pin C are in line with the handle, compute the magnitude of the force supported by the pin at C if P = 200 N. Assume the surface of the bolt head to be smooth. *12*
4. The water storage tank as shown in Fig. Q.4. is a shell of revolution and is to be sprayed with two coats of paint which has coverage of 15 m^2 per liter. The engineer (who remembers mechanics) consults a scale drawing of the tank and determines that the curved line ABC has a length of 12 m and that its centroid is 2.0 m from the centerline of the tank. How many liters of paint will be used for the tank including the vertical column. *12*
5. Determine the moments of inertia of the Z – section shown in Fig.Q.5. about its centroidal x_0 and y_0 axes. *12*

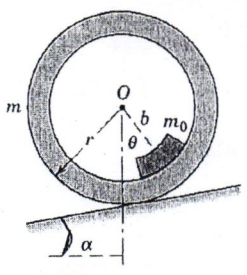

Fig.Q.1

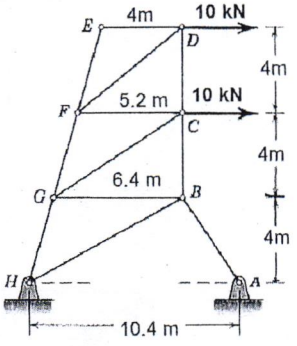

Fig.Q.2

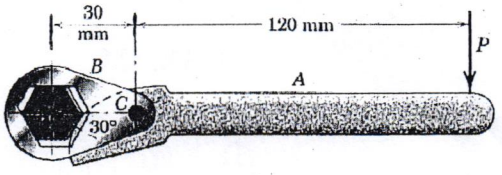

Fig. Q.3

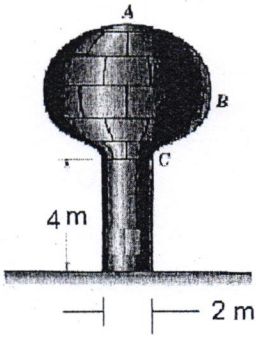

Fig. Q.4

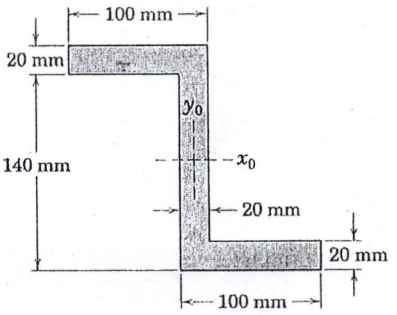

Fig. Q.5

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Part B

(Answer any three Questions)

6. A projectile is launched with speed v_0 from a point A as shown in Fig. Q.6. Determine the launch angle θ that results in maximum range R up the incline of angle $\alpha = 30^\circ$. *11*

7. The motion of the pin A in the fixed circular slot is controlled by the guide B as shown in Fig. Q.7. The guide B is being elevated by its lead screw with a constant velocity $v_0 = 2.1$ m/s for an interval of motion. Calculate both the normal and tangential components of the acceleration of the pin A as it passes the position for which θ $= 30^\circ$. *11*

8. Determine the relationship that governs the velocities of four cylinders as shown in Fig. Q.8. Express all velocities as positive down. How many degrees of freedom are there? *9+2*

9. The small object is placed on the inner surface of the conical dish at the radius as shown in Fig. Q.9. If the coefficient of the static friction between the object and the conical surface is 0.25, for what range of values of angular velocities ω about the vertical axis will the block remain on the dish without slipping? Assume that the speed changes are made slowly so that any acceleration may be neglected. *11*

10. A steel ball of mass m strikes a spring supported steel plate of mass m with a velocity v_o = 15 m/sec at an angle of 60° with the horizontal as shown in Fig Q.10. The coefficient of restitution between the ball and the plate is 0.8. Compute the final velocities of both the masses immediately after the impact. *11*

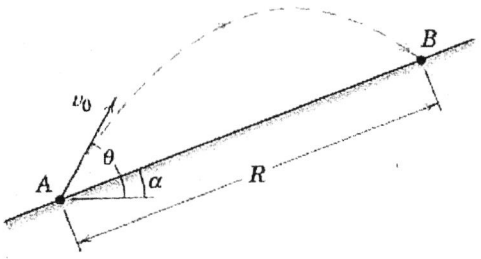

Fig. Q.6

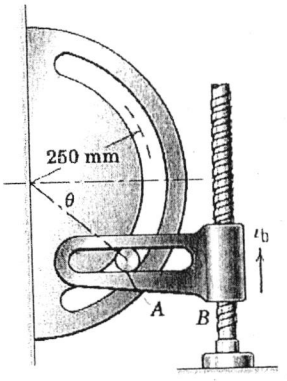

Fig. Q.7

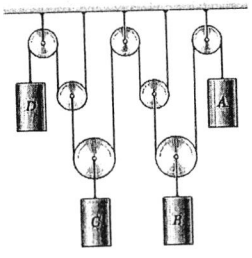

Fig. Q.8

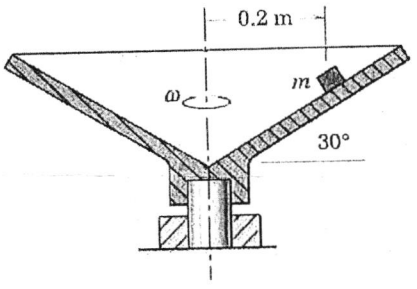

Fig. Q.9

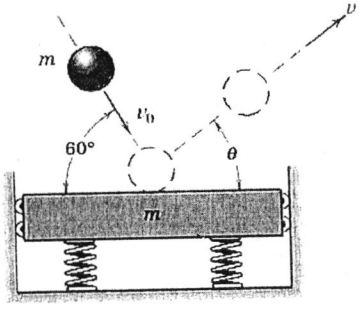

Fig. Q.10