Code: 9A01101

1

B. Tech I Year (R09) Regular & Supplementary Examinations, May 2012

ENGINEERING MECHANICS

(Common to AE, BT, CE & ME)

Time: 3 hours Max Marks: 70

Answer any FIVE questions
All questions carry equal marks
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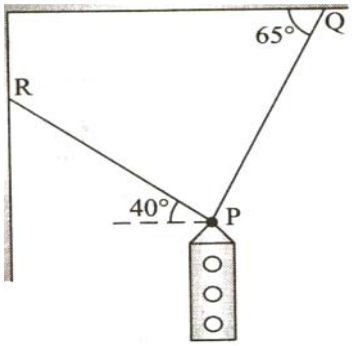
1 A traffic signal of mass 50 kg is hung with the help of two strings, as shown in figure below. Find the forces induced in both the strings.



2 State and explain the necessary conditions of determinacy and stability for truss frame. What is simplest way to convert an unstable frame to statically determinate one?

3 (a) Explain the types of friction with examples.
(b) Two equal bodies A and B of weight 'W' each are placed on a rough inclined plane. The bodies are connected by a light string. If μA = 1/2 and μB = 1/3, show that the bodies will be both on the point of motion when the plane is inclined at tan−1 (5/12).

4 Determine the center of gravity of solid hemisphere of radius 'r' from the diametral axis.

5 (a) Define the terms centroid, moment of inertia and radius of gyration.
(b) Find the area moment of inertia of an equilateral triangle of side 'a' with respect to one of its side.

6 (a) The distance covered by a freely falling body in the lost one second of its motion and the covered in the lost but one second are in the ratio is 5:4. Calculate the height from which the body was dropped and the velocity with which it strikes the ground.
(b) A stationary car attains a maximum permissible speed of 80 Kmph in a distance of 40 m. It continues at this speed for a distance of 200 m and then uniform retardation brings it to a stop in 10 seconds. How for does the car travel from the starting point and what is the total elapsed time?

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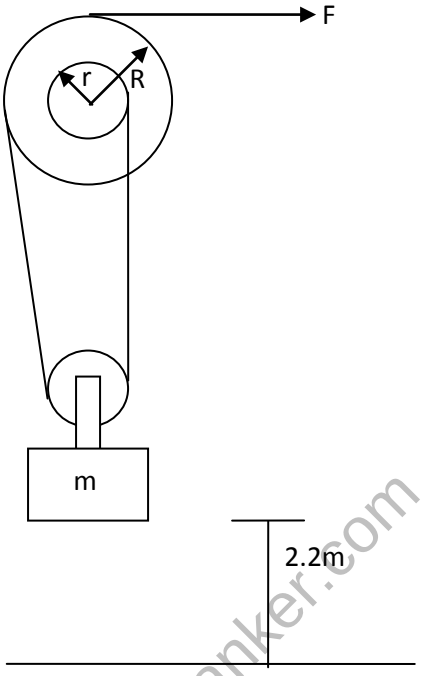
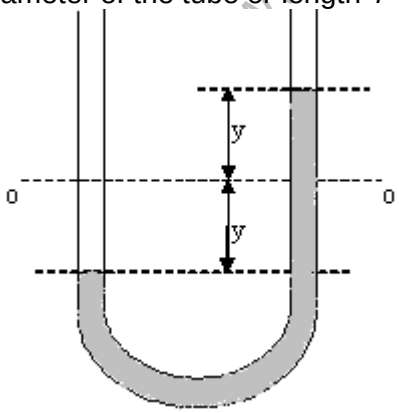
7 A differential chain-hoist system, as shown in figure has the two step upper pulley having centroidal mass moment of inertia of 13.5 NM/s^2. The system raises very slowly a block of mass 100 kg, by means of application of a force F. Suddenly the chain slipped from the hands of the labourer and the block hits the floor 2.2 m below. Determine the velocity of hitting. Assume the chain is mass less and negligible friction in the lower pulley. Take R = 0.31 m, r = 0.16 m. Consider frictional torque is 1/20 times the weight of the block.



8 A vertical U-tube manometer contains a liquid of mass density 'P' as shown in the fig. A sudden increase of pressure on the column forces the level of the liquid down. When the pressure is released, the liquid column starts vibrating. Neglecting the frictional damping, determine the period of vibration. Comment if the period is affected by changing the liquid, diameter of the tube or length '*l*' of the liquid column.



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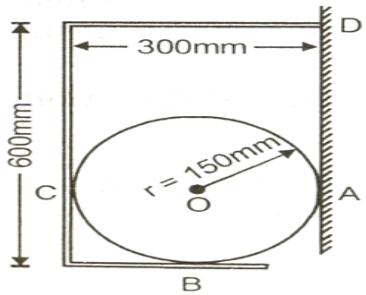
1 A 600N cylinder is supported by the frame BCD as shown in figure. The frame is hinged at D. Determine the reactions at A, B, C and D.



2 What is the difference between a truss and frame? Write down the basic assumptions for frame analysis. And discuss two methods for analyzing the frame for different forces.

3 A screw jack has square threads 50 mm mean diameter and 10 mm pitch. The load on the jack revolves with the screw. The coefficient of friction at the screw threads is 0.05.
i) Find the tangential force required at the end of 300mm leve5r to lift a load of 6000 N.
ii) State the jack is self locking. If not, find the torque which must be applied to keep the load from descending.

4 A steel cylinder of diameter 200 mm and height of 300mm rests centrally over a concrete rectangle of 1000 x 800 x 600 mm size. Determine the center of gravity of the system, taking weight of concrete = 28500 N/m² and that of steel 81000 N/m².

5 Derive the expression for mass moment of inertia of a homogeneous sphere of radius 'r' and mass density 'w', with reference to its diameter.

6 (a) A radar equipped police car notes a vehicle travelling at 110 Kmph. The police car starts pursuit of the vehicle 30 seconds after the observation and accelerates uniformly to 160 Kmph, in 20 seconds. Assuming that speeds are maintained on a straight road, how far from the observation point will the chase end?

(b) A train moving with constant acceleration travels 7 m during the 10^{th} second of its motion and 5 m during the 12^{th} second of its motion. Find its initial velocity and acceleration.

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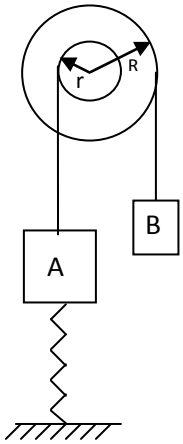
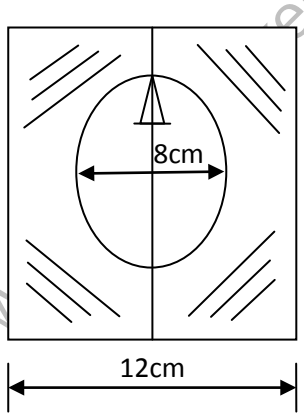
7 Block 'A' initially rests on a spring which is tide with a 75 cm long inextensible cord, as shown in figure. The cord becomes tight home, when the system is released from rest. Determine the stretching of the spring to bring the system at rest. The cylinder weighs 85 kg and rotates on smooth bearings. Consider R = 0.45 m and r = 0.20 m, m_A = 75 kg and m_B = 40 kg. Take spring constant K = 1.5 N/mm.



8 A homogeneous square plate with a centered hole is supported as a compound pendulum as shown in figure. Calculate the time period 'T' for small oscillations in the vertical plane of the plate.



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B. Tech I Year (R09) Regular & Supplementary Examinations, May 2012

ENGINEERING MECHANICS

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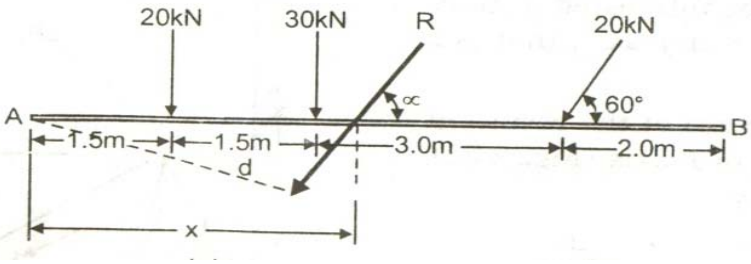
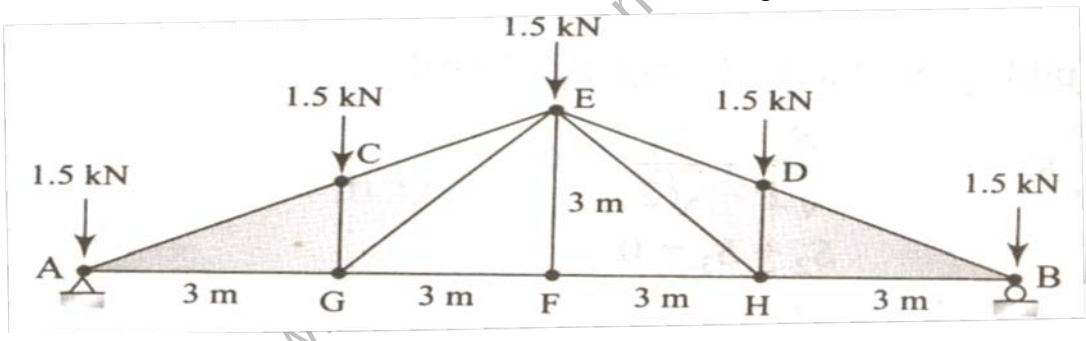
1 A system of loads acting on a beam is shown in figure below. Determine the resultant of the loads.



2 Neglecting any horizontal components of forces in the supports, determine the axial forces in the members of Pratt roof frame as shown in the below figure.



3 A screw jack raises a load of 40 KN. The screw is square threaded having 3 threads per 20 mm length and 40 mm in diameter. Calculate the force required at the end of a lever 400 mm long measured from axis of screw, if coefficient of friction between screw and nut is 0.12.

4 A steel ball of diameter 150 mm rests centrally over a concrete cube of size 150 mm. Determine the center of gravity of the system, taking weight of concrete = 25000 N/m² and that of steel 80000 N/m².

5 A cube of side 400 mm has mass density of 2000 kg/m^3. Find out the mass moment of inertia of the cube about one of its edges and also about its centroidal axis parallel to one digits side.

Contd. in Page 2

6 An enemy ship was located at a distance of 25 km in north – west direction by a warship. If the enemy ship is moving with a velocity of 18 kmph N 30^0 E, in which direction the warship must move with a velocity of 36 kmph to strike at its earliest. Assume the fire range of warship is 5 km. When is the shell to be fired?

7 (a) An automobile moving with a uniform velocity of 40 kmph is accelerated by increasing the traction force by 20%. If the resistance to motion is constant, find the distance traveled before it acquires 50 kmph. Use work-energy method.

(b) A solid cylinder and a sphere are started top of an inclined plane, at the same time, and both roll without slipping down the plane. If when the sphere reaches the bottom of incline, the cylinder is 12 m behind it, what is the total length 'S' of the incline.

8 A particle with a simple harmonic motion has amplitude of 375 mm and a period of π/2 sec. Find the velocity and acceleration of the particle when it has traveled 225 mm to the right of the center of its path. What time is required for this displacement?

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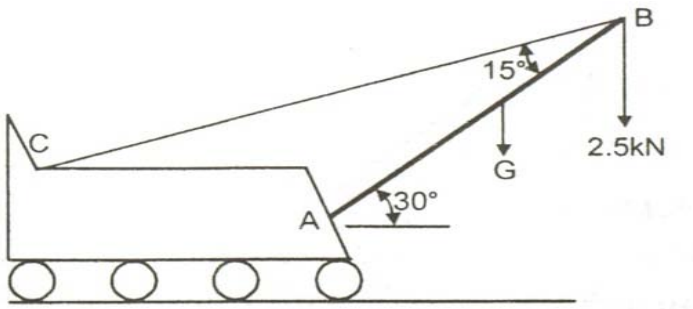
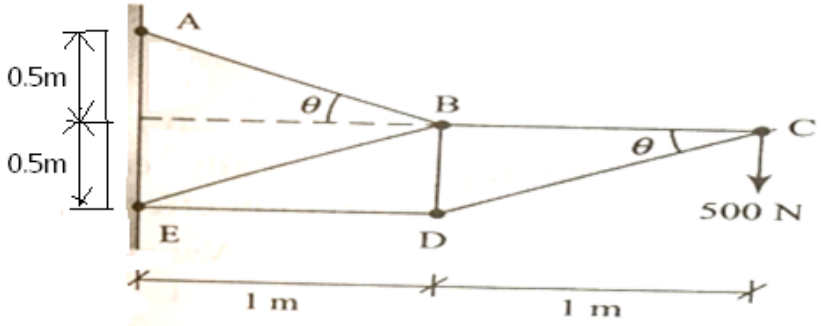
*****

1 The 12 m beam AB weighs 1 KN, the distance of the center of gravity G being 6 m from A. For the position shown, determine the tension T in the cable and the reaction at B [show in figure below]



2 Determine the axial forces in the members of plane frame as shown in the below figure.



3 A block weighing 100 N is resting on a rough plane inclined 20 degrees to the horizontal. It is acted upon by a force of 50 N directed upward at angle of 14^0 above the plane. Determine the friction. If the block is about to move up the plane, determine the co-efficient of friction.

4 (a) Determine the centroid of the quarter circle whose radius R.
(b) Determine centroid of semicircle whose radius R.

5 A cylinder of diameter 500 mm and height 1200 mm has mass density of 8000 kg/m^3. Find out the mass moment of the inertia of the cylinder: (a) with respect to the axis of the cylinder and (b) about a line, which coincides with an end face of the cylinder and passing through center of this face.

Contd. in Page 2

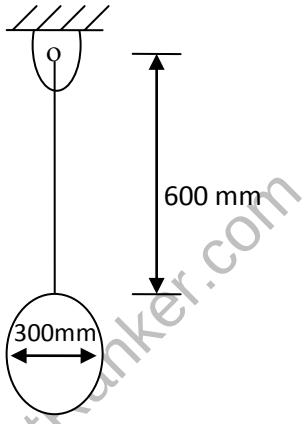
6 (a) A stone dropped into well is heard to strike the water in 3.5 sec. Find the depth of the well assuming the velocity of the sound is 335 m/sec.

(b) Maximum range of a field gun is 2000 m. If a target at a distance of 1200 m is to be hit, what should be the angle of projection.

7 (a) State the principle of the conservation of momentum.

(b) A golfer hits a 46 g ball with an initial velocity of 48 m/sec at an angle of 24^0 with the horizontal. Determine: (i) The initial KE of the ball. (ii) The KE of the ball when it reaches its maximum height.

8 The compound pendulum shown in figure consists of a slender rod of 600 mm long weighing 30 N to which is attached a solid circular disc of 3000 mm diameter that weighs 40 N. Compute the period of oscillation.



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