B. Tech
BENG 1101

First Semester Special Examination – 2012
MECHANICS (OLD COURSE)
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) In a concurrent force system, two forces are acting on a point at an angle 60^0. The resultant force is 80 KN and one of the forces is 30 KN. Determine the other force.
   (b) Explain 'free body diagram' with an example.
   (c) State the laws of friction.
   (d) Differentiate between active forces and reactive forces.
   (e) Explain virtual work.
   (f) Why the trajectory of a projectile is a parabola?
   (g) Define centre of mass and centre of gravity.
   (h) What is the relation between impulse and momentum?
   (i) State and explain law of conservation of energy.
   (j) What do you mean by plane curvilinear motion?

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2. (a) Explain what do you mean by concurrent forces in a plane? What is the condition for equilibrium of concurrent forces in a plane? **(5)**
   (b) Locate the centroid of the area enclosed between a straight line $y = 2x$ and the parabola $y^2 = 4x$. **(5)**

3. (a) A smooth circular cylinder of radius 2 m is lying in a triangular grove, one side of which makes 20^0 angle and the other 50^0 angle with the horizontal. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weighs 100 kN. **(6)**

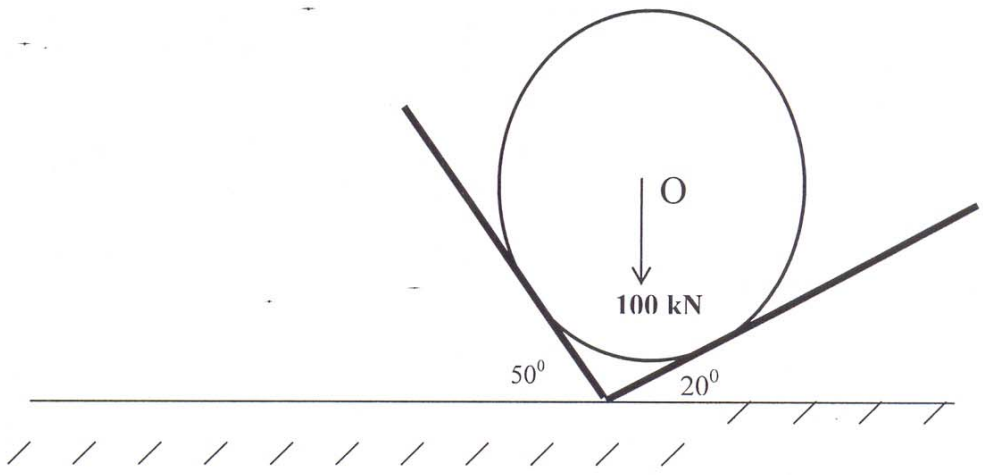

Figure 1

(b) Two man carry a weight of 25 kN by means of two ropes fixed to the weight. One rope is inclined at 40^0 and the other at 25^0 with the vertical. Find the tension in each rope. **(4)**

4.(a) State and explain Pappus theorem with neat diagrams. **(5)**

(b) A spring gun, having a spring constant of 4 N/mm is held on a vertical position. If the original compression of the spring is 200 mm, how high above its compressed position will it project a ball of weight 20 N ? What will be the velocity of the ball at a height of 2 m? **(5)**

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5. Find the polar moment of inertia at the centroid of the L section shown in Figure 2. The section has a thickness of 30 mm throughout . **(10)**

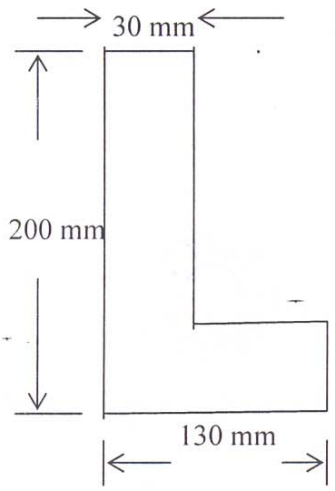

Figure 2

6.(a) An 80 kg man sits in a 50 kg canoe and fires a 100 gm bullet horizontally directly over the bow of the canoe. Neglecting friction of water, find the velocity 'v' with which the canoe will move after the shot if the rifle has a muzzle velocity of 500 m/s. (5)

(b) Two adjacent guns having the muzzle velocity of 400 m/s fire simultaneously at an angle and for the same target at a range 5000 m. Calculate the time difference between the hits. (5)

7.(a) A ball of mass m is dropped on to a spring of stiffness k from a height h. Find the deflection of the spring if the ball is brought to rest. (5)

(b) A bullet moving at the rate of 300 m/sec is fired into a thick target and penetrates 0.6 meters. If it is fired with same velocity into a 0.25 m thick target, find the velocity of emergence. Assume the resistances to be uniform in both the cases. **(5)**

8. Write short notes of the followings (2.5x4)
   (a) Method of joints
   (b) Angular velocity
   (c) D' Alembert's Principle
   (d) Angle of friction and angle of repose.