Total number of printed pages – 8 **B. Tech**

BENG 1101

Second Semester Examination – 2008

MECHANICS

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) State the conditions under which two concurrent forces are in equilibrium.

   (b) Draw the free body diagram of a ball rest against a smooth wall and held in position by an inclined string which making angle α with the vertical wall.

   (c) Differentiate limiting friction, static friction and dynamic friction.

   (d) Prove that the rate of change of momentum is impulse.

   (e) Show that the polar moment of inertia of any plain figure with respect to a point in its plane is equal to the sum of the moments of inertia of the figure with respect to the two orthogonal axes through that point and also in the plane of the figure.

   (f) State the equations of motion for uniformly accelerated case.

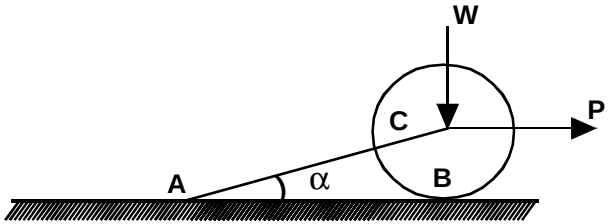
   (g) A disc is rotating with constant angular velocity of 10 rad/sec. What will be the velocity at point 0.3 m from centre along a radius and radius is 0.6 m ? Also find out the radial acceleration at that point.

   (h) Find the pressure transmitted to the feet of a man of weight 500 N standing in a lift that moves downward with an acceleration of 3 m/s^2.

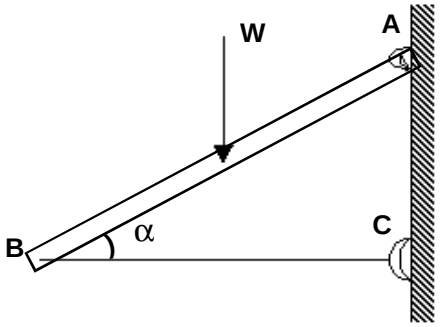
   (i) What are the specifications of force ?

   (j) What is the conservative system ? State and explain the “Law of conservation of Energy”.

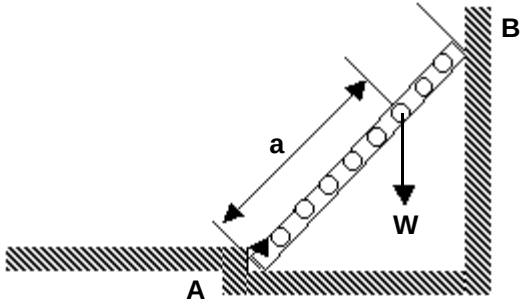
2. (a) A right circular roller of weight W rests on a smooth horizontal plane and is held in position by an inclined bar AC as shown in fig. Find the tension S in the bar AC and the vertical reaction R_b at B if there is also a horizontal force P acting at C. 5



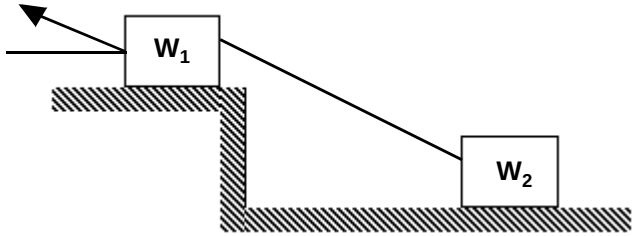
(b) A prismatic bar AB of weight W = 62.3 N and length L = 2.44 m is hinged to a vertical wall at A and supported at its other end B by a horizontal strut BC as shown in Fig. Find the compressive force S induced in the strut and the reaction R_a at A if α is 25°. 5



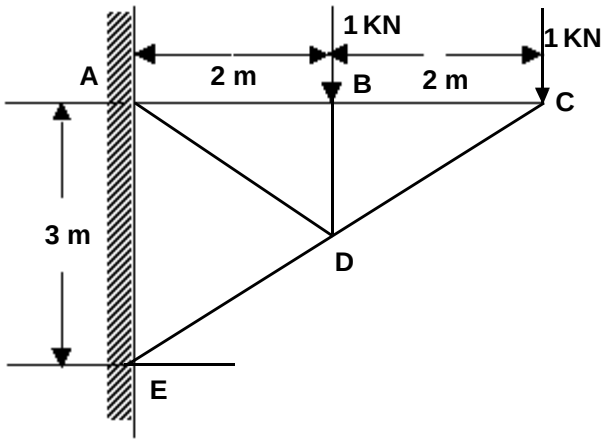
3. (a) A long ladder of length L supported at A and B as shown in fig. A vertical load W can have any position as defined by the distance ''a'' from the bottom. Neglecting friction determine the magnitude of the reaction R_b at B. Neglect the weight of the ladder. 4



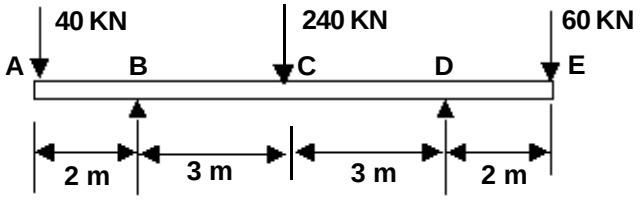
(b) Two blocks having weights W_1 and W_2 are connected by a string and rest on horizontal planes as shown in fig. If the angle of friction for each block is α, find the magnitude and direction of the least force P applied to the upper block that will induce sliding. 6



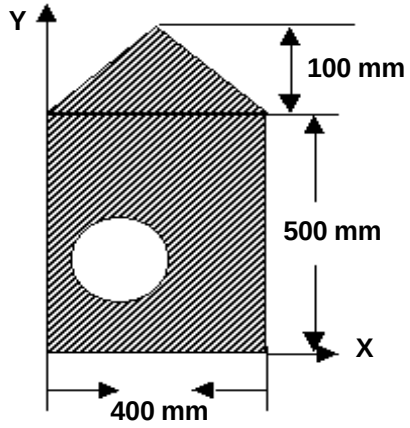
4. (a) Determine the axial force in each bar of the plane truss loaded as shown in fig. 6



(b) Using the principle of virtual work determine the reactions of a beam AE as shown in the Fig. 4



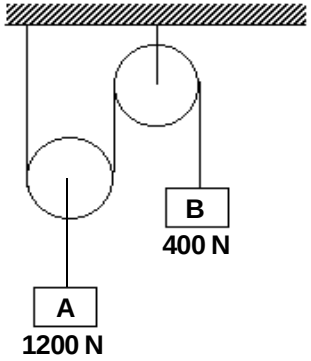
5. (a) Locate the centroid of the fig as shown w.r.t. axis X and Y, if the triangle is a isosceles triangle and Coordinates of the centre of the circle is (150 mm, 200 mm) w.r.t. X-Y plane and radius 10 mm. 6



(b) Find the moment of inertia of a triangle of base 'b' and height 'h' about an axis passing through its centroid and parallel to its base. 4

6. (a) A train starting from rest is uniformly accelerated during the first 250 m of its run, after which it runs the next 750 m at the uniform speed acquired. It is then brought to rest in 50 seconds, under uniform retardation. If the time of entire journey is 5 minutes, find the acceleration with which the train started and the retardation with which it stopped. 4

(b) Determine the tension in the string and acceleration of the blocks A and B weighing 1200 N and 400 N connected by a string as shown in the fig. Assume pulleys are weightless and frictionless. 6



7. (a) A boy wishes to throw a ball over a flat-roofed school house that stands 12 m wide and 7.5 m high on the level ground. Assuming that the ball will leave his hand at a height of 1.5 m above the ground, determine how far from the wall he should take his stand in order to make the ball clear the roof with the least effort i.e. with the minimum initial velocity. 6

(b) A golf ball dropped from the rest on to a cement sidewalk rebounds eight-tenths of the height through which it fell. Neglecting air resistance, determine the co-efficient of restitution. 4

8. (a) Racing cars travel around a circular track of 300 m radius with a speed of 384 km/h. What angle should the floor of the track make with horizontal in order to safeguard against skidding ? 3

(b) A wheel rotating about a fixed axis at 20 r.p.m., is uniformly accelerated for 70 seconds, during which time it makes 50 revolutions. Find (i) angular velocity at the end of this interval and (ii) Time required for the speed to reach 100 revolution per minute. 7

———————