Code No: 111AC

R13

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech I Year Examinations, May - 2018

ENGINEERING MECHANICS

(Common to CE, ME, MCT, MMT, AE, AME, MIE, PTM, CEE, AGE)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.
Illustrate your answers with NEAT sketches wherever necessary.

PART- A

(25 Marks)

1.a) State the conditions for a particle to be in equilibrium in space. [2]

b) Classify the system of forces with neat sketches. [3]

c) What are surface irregularities? How do they affect the relative motion of bodies over one another? [2]

d) Explain the terms: Limiting friction, Angle of repose, Coefficient of static friction. [3]

e) Under what condition is the i) centre of gravity of a wire same as the centroid of its centre line, ii) centre of gravity of a plate same as the centroid of its surface area? [2]

f) Show that the mass moment of inertia of a thin circular ring of mass M and mean radius R with respect to its geometrical axis is MR^2. [3]

g) Express the velocity and acceleration vectors in terms of rectangular components. [2]

h) A cannon can fire a bomb with a release velocity of 75 m/s. If the length of the barrel is 1 m, and the mass of the bomb is 1200 kg, determine the force acting on the bomb. [3]

i) Distinguish between centre of oscillation and centre of suspension. [2]

j) State the kinetic equations of motion in i) centroidal rotation, ii) non – centroidal rotation, and iii) general plane motion. [3]

PART-B

(50 Marks)

2. A system of forces act as shown in figure 1. Find the magnitude of the forces A and B so that the resultant of the force system passes through P and Q. [10]

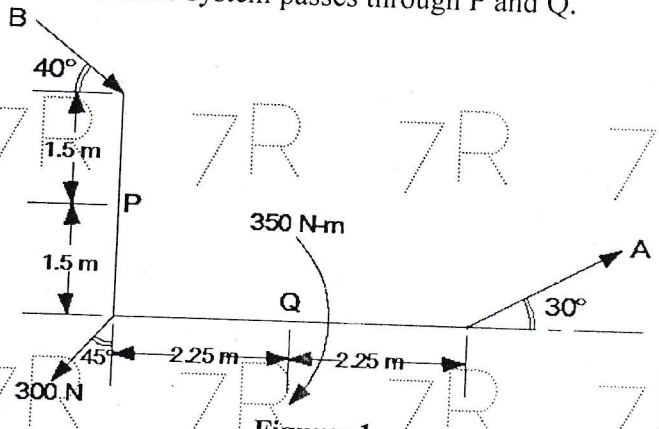

Figure: 1

OR

3. Determine the resultant of the force system acting in the plane shown in figure 2. Locate the distance from A where the resultant cuts the $x-$axis. [10]

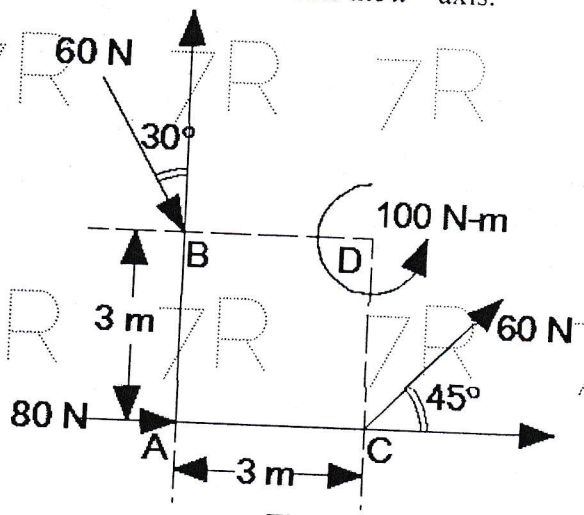

Figure: 2

4. A 12^0 wedge is pushed inside a gap in between two blocks by a vertical force P as shown in figure 3. Determine the value of P to just move the 1000 kg block to the left. Also, find the value of W to maintain equilibrium. The coefficient of friction at all the contact surfaces is 0.25. [10]

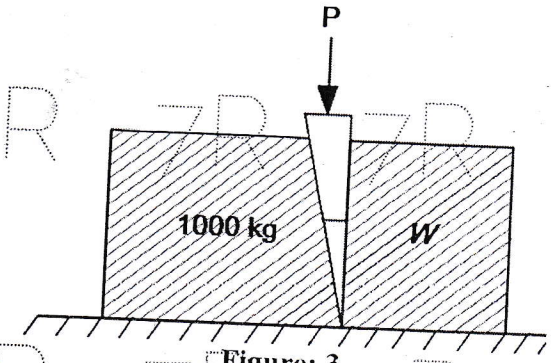

Figure: 3

OR

5. What maximum HP can be transmitted per square cm of cross-section, if the tension in the belt is not to exceed 25 kg/cm^2 and the ratio of the tension in the tight side to the tension in the slack side is 1.8? Assume the weight of 1 cu cm of belt as 0.0011 kg. [10]

6. A cone of base diameter 200 mm is fitted centrally to a hemisphere of diameter 200 mm. What should be the height of the cone so that the centroid of the combination solid lies at the junction between the cone and hemisphere? [10]

OR

7. Find the moment of inertia of the section shown in figure 4 about the x and y centroidal axes. All dimensions are in mm. [10]

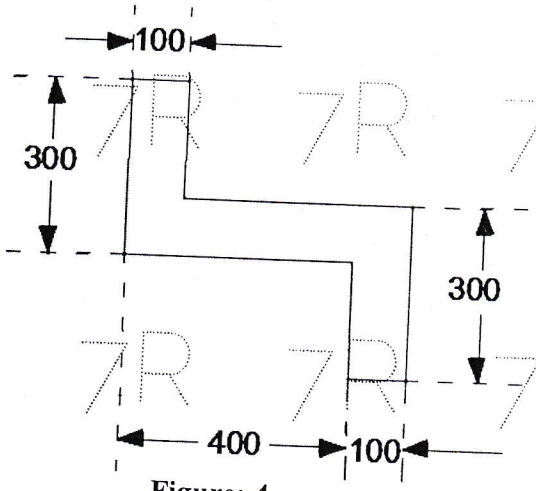

Figure: 4

8. A projectile is fired with an initial velocity of 250 m/s at a target located at a horizontal distance of 4 km and a vertical distance of 700 m above the gun. Determine the value of the firing angle to hit the target. Neglect air resistance. [10]

OR

9.a) The angular rotation of a body is given as the function of time by the equation $\theta = \theta_0 + at + bt^2$, where θ_0 is the initial angular displacement, a and b are constants. Obtain the general expression for the (i) angular velocity, and (ii) angular acceleration of the body. If the initial angular velocity be 3π radians/s, and after two seconds the angular velocity is 8π radians/s, find the constants a and b.

b) Derive the $x - t$, $v - t$, and $a - t$ relationships for uniformly accelerated motion. [5+5]

10.a) Determine the angular velocity of the earth assuming it to be a perfect square revolving about the north and south poles. If the radius of earth is 6370 km, and its mass is 6×10^{24} kg, find its angular momentum and rotational kinetic energy.

b) State the work – energy principle and conservation of mechanical energy for a rigid body motion. [5+5]

OR

11.a) A body of 4 kg mass, when suspended from a spring, extends it by 10 cm. If a body of mass 1.5 kg is suspended from the same spring, determine the elongation of the spring. If it is pulled by 1 cm from its equilibrium position and released, determine the period of vibration, amplitude, and maximum velocity.

b) Distinguish between simple pendulum and compound pendulum. [5+5]

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