## R16

## Code No: 131AE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

## B.Tech I Year I Semester Examinations, May/June - 2017

ENGINEERING MECHANICS
(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, MMT, MIE, CEE, MSNT)

Time: 3 hours

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 $\mathrm{a}, \mathrm{b}, \mathrm{c}$ as sub questions.

## Part- A ( 25 Marks)

1.a) Define the term free body diagram and state the importance of drawing such diagram.
b) A force $\mathrm{F}=(10 \mathrm{i}+8 \mathrm{j}-5 \mathrm{k}) \mathrm{N}$ acts at point $\mathrm{A}(2,5,6) \mathrm{m}$. What is the moment of the force about the point $\mathrm{B}(3,1,4)$.
c) Define angle of friction and angle of repose.
d) The force required to pull a body of weight 100 N on a rough horizontal plane is 30 N . Determine the coefficient friction if the force applied is at an angle of $15^{\circ}$ with the horizontal.
e) Find the centrodal coordinates of rectangular area of width $w$ and depth d.
f) Determine the moment of inertia of an area semi-circle of radius 2.5 cm about the centroidal x and y axes.
g) State parallel axis theorem as applied to mass moment of inertia.
h) Mention the forces which are generally omitted while applying the principle of virtual work.
i) Write the impulse-momentum equation and mention its application.
j) Show that when a particle moves with simple harmonic motion, it's time for complete oscillation is independent of the amplitude of its motion.

## Part-B (50 Marks)

2.a) A bracket is constructed by attaching member ABC to wall CD with a frictionless hinge at C and a horizontal cable at A , as shown in Figure 1. A smooth cylinder of weight 1.2 kN is placed in the bracket as shown. Determine the force acting on the cylinder at contact points B and D and the tension in the cable and reactions at support C .


Figure: 1
b) Refer to figure 2. If the maximum allowable strength for each cable is 10.5 kN , determine the permissible weight of the homogeneous circular plate of diameter 4 m .
[5+5]


Figure: 2
OR
3.a) Find the reactions at supports A and B for the force system acting on the beam as shown in Figure 3.


Figure: 3
b) A crate of weight $\mathrm{W}=1.5 \mathrm{kN}$ is suppotted as shown in figure 4 , by members AO and AB and cable AC. Determine the force in the cable AC and in members AO and AB. [5+5]


Figure: 4
4.a) As shown in figure 5, two blocks each weighing 20 kN and resting on a horizontal surface, are to be pushed apart by a $30^{\circ}$ wedge. The angle of friction is $15^{\circ}$ for all contact surfaces. What value of P is required to start movement of the blocks?


Figure: 5
b) A screw jack has square threads of mean diameter 6 cm , of helix angle $10^{\circ}$ and coefficient of friction 0.25 . Determine the force that must be applied to the end of 50 cm lever to i) rise ii) lower a weight of 2500 N .

## OR

5.a) A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of $70^{\circ}$ with the horizontal. The weight of the ladder is 300 N . The ladder is on the verge of sliding when a man weighing 750 N stands on a rung 1.5 m along the ladder. Calculate the coefficient of friction between the ladder and the floor.
b) What should be the value of $\theta$ in figure 6 which will make the motion of 900 N block down the plane to impend? The coefficient offriction for all contact surfaces is 0.3 . [5+5]


Figure: 6
6.a) Find the centroidal coordinates of the area of the plane as shown in figure 7. Given $\mathrm{a}=30 \mathrm{~cm}, \mathrm{~b}=30 \mathrm{~cm}, \mathrm{c}=60 \mathrm{~cm}, \mathrm{~d}=40 \mathrm{~cm}$, and $\mathrm{r}=20 \mathrm{~cm}$.

b) For the shaded area as shown in figure 8, determine the Moment of Inertia of an area of plane figure about their centroidal axes. All units are in centimeters.


Figure: 8
OR
7.a) Determine the centroidal coordinates of shade area with respect to x and y axes as shown in figure 9 .


Figure: 9
b) Determine the moment of inertia an area of a triangle with a rectangular cut as shown in figure 10 , about the base $A-B$ and the centroidal axis parallel to $A B$. (All dimensions are in Centimetres).

8.a) Find the mass moment of inertia of a solid sphere of radius $r$ and mass $m$ about any axis.
b) The arrangement as shown in figure 11 is required to remain in state of equilibrium. Derive an expression for tension in the cable in terms of $\theta$ and W . Use method of virtual work.


Figure: 11
OR
9.a) Find the mass moment of inertia of a solid cylinder of radius $r$, height $h$ and mass $m$ about centroidal x and y axes.
b) A uniform ladder of 200 N weights rests against a smooth vertical wall and a rough horizontal floor making an angle of $60^{\circ}$ with the horizontal. Use the method of virtual work, find the frictional force between the foot of the ladder and the rough horizontal floor.
10.a) An elevator gross weight 15 kN is moving in the upward direction, such that the displacement is given by $x_{0}=4 t^{2}+6 t+7 \mathrm{~m}$. Determine the tension in the cable supporting the elevator at $t=2$ seconds.
b) A car starts from rest on a curved road of 250 m radius and accelerates at a constant tangential acceleration of $0.6 \mathrm{~m} / \mathrm{sec}^{2}$. Determine the distance and time for which that car travel before the magnitude of total acceleration attained it becomes $0.75 \mathrm{~m} / \mathrm{sec}^{2}$. [5+5]

## OR

11.a) A body of mass 10 kg is suspended by a string of length 1 m . It is struck by a bullet travelling horizontally with a velocity of $450 \mathrm{~m} / \mathrm{sec}$. The bullet weights 30 grams and gets embedded into the body after striking it. Determine the maximum angle through which the body swings.
b) A body moving with simple harmonic motion has amplitude of 1 m and a period of oscillation of 2 seconds. What will be its velocity and acceleration 0.4 seconds after passing an extreme position?

