IX. Old Question Papers

Code No: 152AH **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year II Semester (Special) Examinations, January - 2021
ENGINEERING MECHANICS
(Common to CE, ME, MCT)

Time: 2hrs **Max.Marks:75**

Answer any five questions
All questions carry equal marks

1.a) Prove Varignon's principle of moments.
b) Differentiate between:
i) Concurrent and non-concurrent forces
ii) Coplanar and non-coplanar forces
iii) Moment of force and couple. [7+8]

2. Three cylinders weighing 100 N each and of 80 mm diameter are placed in a channel of 180 mm width as shown below figure 1. Determine the reactions exerted by a) the cylinder A on B at the point of contact and b) the cylinder B on the base and on the wall. [7+8]

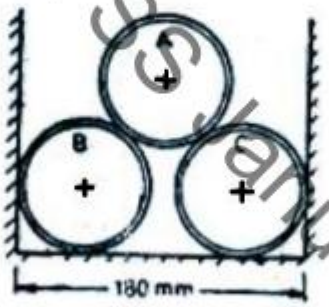

Figure: 1

3. The efficiency of a screw jack will be maximum for raising a load W, if $\alpha = 45^{\circ} - \phi/2$. Derive an expression for the above condition and prove that the maximum efficiency is given by: $\eta_{max} = 1-\sin\phi/1+\sin\phi$. [15]

4.a) Define the terms moment of inertia and radius of gyration.
b) Prove that the moment of area of any plane figure about a line passing through its centroid is zero. [7+8]

5. Derive an equation for mass moment of inertia of circular plate of radius 'R' and thickness 't' about its diameter. [15]

6.a) A car accelerates uniformly from a speed of 30 Km/Hr to a speed of 75 Km/Hr in 5 secs. Determine the acceleration of the car and the distance traveled by the car during 5 secs.
b) State the law of conservation of momentum. [10+5]

7. Two blocks of weight 150 N and 50 N are connected by a string and passing over a frictionless pulley as shown in figure 2. Predict the acceleration of blocks A and B and the tension in the string. [15]

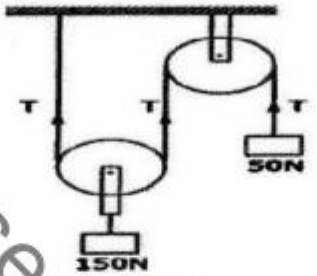

Figure: 2

8. Two weights 800 N and 200 N are connected by a thread and they move along a rough horizontal plane under the action of a force of 400N applied to the 800 N weight as shown in figure 3. The coefficient of friction between the sliding surface of the weights and the plane is 0.3. Using Alembert's principle, determine the acceleration of the weight and tension in the Thread. [15]

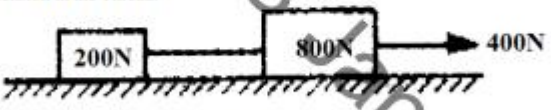

Figure: 3

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Code No: 152AH **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year II Semester Examinations, June - 2022
ENGINEERING MECHANICS
(Common to CE, ME, MCT, MMT, AE, MIE, PTM)

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

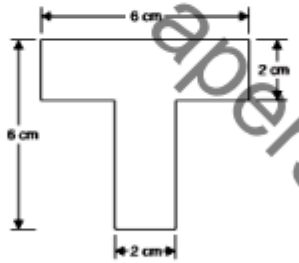
Answer any five questions
All questions carry equal marks

- - -

1.a) State and explain the triangle law of forces and polygon law of forces.
b) Three forces acting on a rigid body, are represented in magnitude, direction and line of action by the three sides of a triangle taken in order. Prove that the forces are equivalent to a couple whose moment is equal to twice the area of the triangles. [5+10]

2.a) How will you distinguish between static friction and dynamic friction?
b) Determine the centroid of the area remaining after a circle of diameter r is removed from a circle of diameter. [7+8]

3.a) State and explain the theorem of parallel axis for the moment of inertia f a plane lamina.
b) Calculate the moment of inertia about horizontal and vertical gravity axis of the section of the given figure. [6+9]



4.a) Determine the moment of inertia of a circle about its diametral axis from the first principles.
b) Describe the method of finding out the moment of inertia of a composite section. [8+7]

5.a) Derive the differential equation of curvilinear motion.
b) What is the work done by the weight of a body if it is moved horizontally? [8+7]

6.a) State the principle of conservation of energy? What is the fundamental interpretation of kinetic energy.
b) A Car is travelling east at a constant speed 7 m/s, at the same time another car starts from rest towards north with a constant acceleration of 2 m/s^2. Determine the position, velocity and acceleration of second car relative to the first car after 5 seconds. [5+10]

7.a) State and explain D'Alembert's principle and its application in plane motion.
b) The speed of the flywheel increase from 300 to 600 rev/min in 10 seconds. If the diameter of the wheel is 2m, Determine the angular acceleration and number of revolutions made during this period of 10 seconds. Find the normal and tangential acceleration at the rim of the wheel at the end of 10 seconds. [4+11]

8.a) Explain the instantaneous centre of rotation of a plane motion.
b) State and discuss the principle of work and energy. [8+7]

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Code No: 131AE

R16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year I Semester Examinations, December - 2017
ENGINEERING MECHANICS
(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, ETM, MMT, AE, MIE, PTM, CEE, MSNT)

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.

PART- A

(25 Marks)

1.a)	State the theorem of varignon.	[2]
b)	Write the equations of equilibrium of a coplanar system of forces.	[3]
c)	Define rolling resistance.	[2]
d)	Define wedge and write the equilibrium conditions for ladder friction.	[3]
e)	Define centroid and centre of gravity of a area.	[2]
f)	Define principal axes and principal moment of inertia.	[3]
g)	Define radius of gyration and polar moment of inertia.	[2]
h)	Differentiate between "Mass moment of inertia" and "Area moment of inertia".	[3]
i)	Differentiate the kinematics and kinetics.	[2]
j)	State work-energy principle for Linear and angular motion of a rigid body.	[3]

PART-B

(50 Marks)

2.a) A 800N Cylinder is supported by the frame ABC, figure 1 which is hinged at A, and rests against wall AD. Determine the reactions at A, B, C and D.

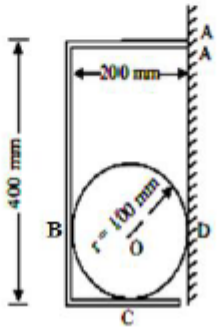


Figure: 1

b) The body shown in figure 2 is acted upon by four forces. Determine the resultant. [5+5]

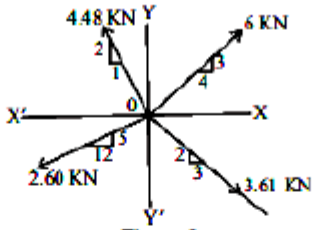


Figure: 2

OR

3.a) Concurrent forces 3P, 7P and 5P act respectively along three directions, which are parallel to the side of an equilateral triangle taken in order. Determine the magnitude and direction of the resultant.

b) What do you understand by resultant of a force system and which are the methods used for determining the resulting of coplanar concurrent force system? Four forces having magnitudes of 20N, 40N, 60N and 80N respectively, are acting along the four sides (1m each), of a square ABCD taken in order, as shown in figure 3. Determine the magnitude and direction of the resultant force. [5+5]

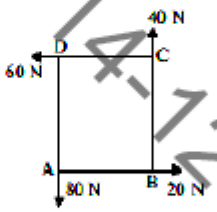


Figure: 3

4.a) What is the characteristics of frictional force? Describe the laws of coulomb friction, explaining the concept of equilibrium of bodies involving dry friction.

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 $\mu_A = 1/2$ and $\mu_B = 1/3$, show that the bodies will be both on the point of motion when the plane is inclined at $\tan^{-1}(5/12)$. [5+5]

OR

5.a) Explain the principles of operation of a screw-jack with a neat sketch.

b) A body of weight 100N rests on a rough horizontal surface ($\mu = 0.3$) and is acted upon by a force applied at an angle of 30^0 to the horizontal. What force is required to just cause the body to slide over the surface? [5+5]

6.a) Determine the distance of the center of gravity of a homogeneous truncated right circular cone from the plane of the base if the radius of the base is r_1 the radius of the top r_2 and the altitude of the truncated portion h.

b) Determine the mass moment of inertia of a solid right circular cylinder of uniform density with respect to its centroidal diameter the radius of the cylinder is **R** and its length is **H**. [5+5]

OR

7.a) Derive an expression to determine the moment of inertia of a semi circle about its diametric base.

b) Determine the y coordinate of the centroid of a uniform triangular lamina as shown in Figure 4. [5+5]

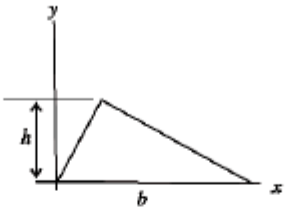


Figure: 4

8. Derive the expression form mass moment of inertia of prism along three axes. [10]

OR

9. Discuss about the expression for finding mass moment of inertia of a cylinder of radius **R** and height **h** about its base. [10]

10.a) A body moves along a straight line and its acceleration 'a' which varies with time 't' is given by a =6-4t. Five seconds after the start of observation, the velocity is 18 m/s. The distance moved by the body 8 sec after the start of observation of motion from origin is 75 m. Determine:
i) The acceleration, velocity and distance from the origin at the start of observation.
ii) The time after the start of observation at which the velocity becomes zero and the distance travelled from the origin.

b) A man weighing 90 kg stands in a boat so that he is 6 m from pier on the shore. He walks 2.4 m in the boat toward the pier and then stops. How far from the pier will he be at the end of this time? The boat weighs 120 kg and there is assumed to be no friction between it and water. [5+5]

OR

11.a) A vehicle accelerates a glider of 125 kg mass from rest to a speed of 50 km/hr. Make calculations for the work done on the glider by the vehicle. What change would occur in the kinetic energy of the glider if subsequently its velocity reduces to 20 km/hr on the application of brakes?

b) A stone is dropped into a well and falls vertically with constant acceleration g =9.81 m/s^2. The sound of impact of the stone on the bottom of the well is heard 6.5 sec after it is dropped. If the velocity of sound is 340 m/s, find the depth of the well. [5+5]

Code No: 131AE **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year I Semester Examinations, September/October - 2021
ENGINEERING MECHANICS
(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, MMT, AE, MIE, PTM)

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

Answer any five questions
All questions carry equal marks

1.a) Find the resultant of the force acting on a particle P shown in figure 1.

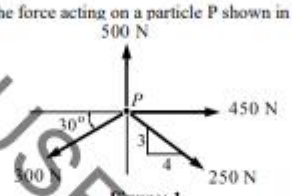


Figure: 1

b) Two identical rollers each of mass 50 kg are supported by an inclined plane and a vertical wall as shown in figure 2. Assuming smooth surfaces, find the reactions induced at the point of support A, B and C. [7+8]

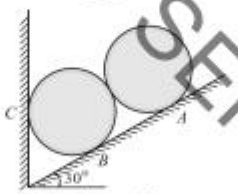


Figure: 2

2.a) State and prove Varignon's theorem.

b) Replace the system of forces shown in figure 3 by an equivalent force-couple system at the origin O. The size of each square in the mesh is 10 cm × 10 cm. [7+8]

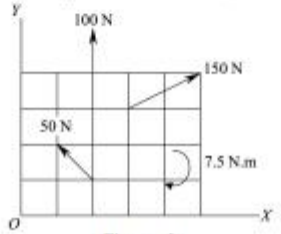


Figure: 3

3.a) A body of weight 200 N is placed on a rough horizontal plane. If the co-efficient of friction between the body and the horizontal plane is 0.3, determine the horizontal force required to just slide the body on the plane.

b) A screw jack carries a load of 10 kN. It has a square threaded screw of pitch 25 mm and mean diameter 60 mm. The coefficient of friction between screw and nut is 0.20. Calculate the torque required to raise the load and the efficiency of the screw. Find also the force required at the end of the handle 500 mm long to lower the load. [7+8]

4. Determine the value of force P required to start the wedge. The block weighs 2000 N and is also subjected to horizontal force of 500 N as shown in the figure 4. The angle of friction at all surfaces is 15^0. [15]

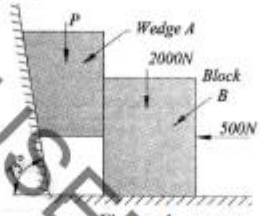


Figure: 4

5.a) State and prove parallel axis theorem for area moment of inertia.

b) Determine the centroid of the area shown in the figure 5 by considering b-b as x-axis and a-a as y-axis. [8+7]

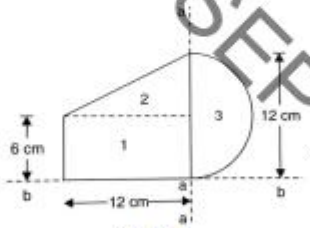


Figure: 5

6.a) Determine the moment of inertia of the rectangle having base width *b* and height *h* about its centroidal axis parallel to the base.

b) Calculate the moment of intertia for the following figure 6 about centroidal axes. [7+8]

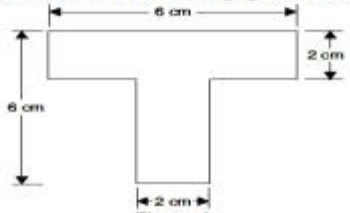


Figure: 6

7. A brass cone with base diameter of 400 mm and height of 225 mm is placed on a vertical aluminum cylinder of height 300 mm and diameter 400 mm. Density of brass = $85kN/m^3$ and density of aluminium = $25.6kN/m^3$. Determine the mass moment of inertia of the composite body about the vertical geometrical axis. [15]

8.a) A car of 2 ton mass starts from rest and accelerates at a uniform rate to reach a speed of 60 kmph in 20 seconds. If the frictional resistance is 600 N/ton, determine the driving power of the engine when it reaches a speed of 60 kmph.

b) A block of 5 kg mass resting on a smooth horizontal plane is attached to a spring as shown in figure 7. It is pulled by a distance of 50 cm from the unstretched position of the spring and released; determine the velocity with which the block crosses the unstretched position. The spring extends by 20 cm when a 4 kg mass is suspended from it. [7+8]

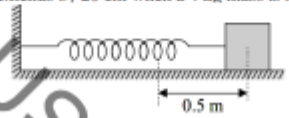


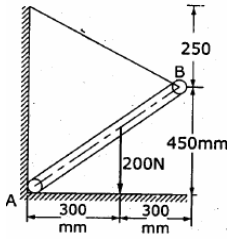
Figure: 7

X. Question Papers (CIA & SEE)

Continuous Internal Assessment Questions

Assignment I:

1. A rod AB of weight 200 N is supported by a cable BD and the corner of wall and floor surfaceas shown in fig. Find the reaction at A and tension in the cord.



2. Reduce the system of forces shown in fig. to a force – couple system at A

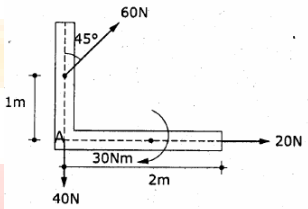
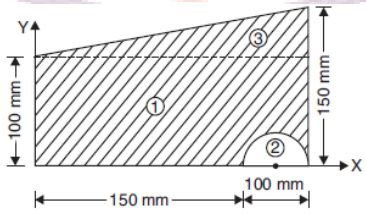
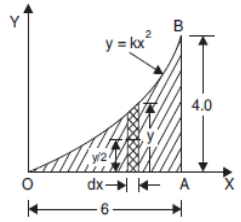


Fig.5

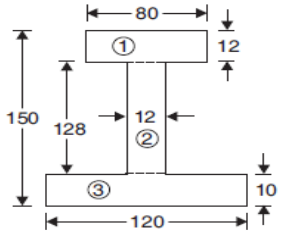
3. A semi-circular area is removed from the trapezoid as shown in Fig. Determine the centroid of the remaining area.



4. Determine the co-ordinates of the C.G. of the area OAB shown in Fig., if the curve OB represents the equation of a parabola, given by $y = kx^2$ in which OA = 6 units and AB = 4 units.

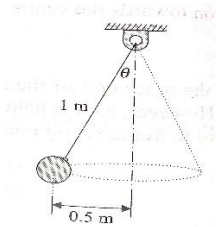


5. Determine the polar moment of inertia of I-section shown in Fig.



Assignment II:

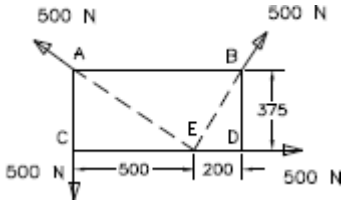
1. Derive the expression for Mass Moment of Inertia of a Right Circular Cone of Base Radius R, Height H and Mass M about its Axis.
2. A bus moving along a curved road with a constant speed of 45kmph decelerates at a constant rate to a halt in 10secs. Determine a total acceleration at the instant the brake is applied. Radius of curvature is 100m.
3. A body of 3kg mass is suspended by an extensible string of 1m length. It is rotated in a circular path of 0.5m radius as shown in fig. Determine the tension in the string and the constant speed of the body.



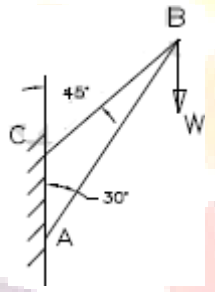
4. A ball of 100g mass is projected up with a velocity of 20m/s. It hits a ceiling that is 10m above the point of projection. If e=3/4, determine the speed of ball as it descends to the point of projection. If the impact duration is $1/150^{th}$ of a second, determine the impulsive force.
5. A body of mass 5kg is tied to an inextensible string. Determine the work done by the external agent on the body, if (i) it is lowered down at a constant speed through a distance of 3m, (ii) if it is lowered down at a constant acceleration of $1m/s^2$ through the same distance, (iii) if it is lifted up at a constant velocity by a distance of 3m, (iv) if it is lifted up at a constant acceleration of $1m/s^2$ by the same distance.

XI. Tutorial sheets

C1.1 Four forces act on a 700mm X 375mm plate as shown in fig. a) Determine the resultant of these forces b) Locate the two points where the line of action of the resultant intersects the edge of plate.

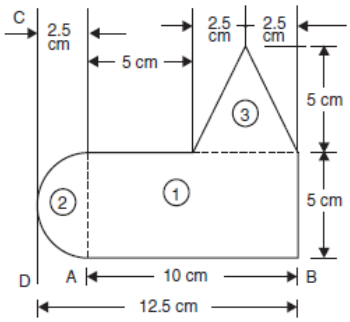


C1.2 A crane shown in figure is required to lift a load of W=10 KN. Find the forces in themembers AB and CB

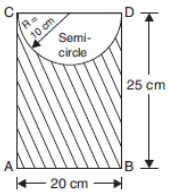


C2.1 A screw-jack is used to lift a load of 5 kN. The jack has screw with square threads having two threads per 12 mm length. If the co-efficient of friction between the nut and the screw is 0.08 and outer dia. of the screw is 60 mm, find the force required at the end of the 600 mm long lever to lift the load

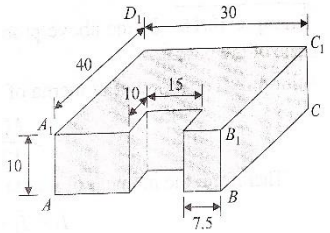
C2.2 Using the analytical method, determine the centre of gravity of the plane uniform lamina shown in Fig.



C3.1 Find the moment of inertia of the area shown shaded in Fig., about edge AB.

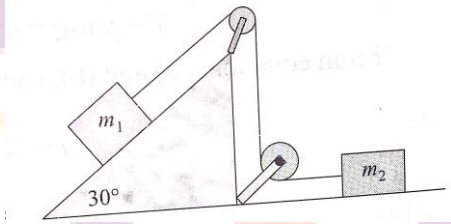


C3.2 From the prism of dimensions 40cmX30cmX10cm, a block of dimensions 10cmX15cmX10cm is removed as shown. Determine the mass moment of inertia of the remaining block about axis CC_1 and AA_1. Take density of material to be $1250kg/m^3$.



C4.1 The driver of the car moving at the constant speed of 36kmph sees the signal turning red when he is 50m from the signal. The reaction time of the driver i.e., the time interval between the perception of a signal to stop and the application of brakes is 0.7s. If the car begins to decelerate at a constant rate upon the application of brakes, determine (i) the minimum deceleration of the car required to bring it to a halt just before the signal, (ii) time taken to bring the car to a halt.

C4.2 Find the expressions for the acceleration of the system shown in fig. and the tension in the string. If m_1=2kg, m_2=1kg, $\theta=30^0$ and μ=0.2 for all contact surfaces, determine the pulleys and masses and friction less and the string is inextensible.



C5.1 A body of mass 5kg is tied to an inextensible string. Determine the work done by the external agent on the body, if (i) it is lowered down at a constant speed through a distance of 3m, (ii) if it is lowered down at a constant acceleration of $1m/s^2$ through the same distance, (iii) if it is lifted up at a constant velocity by a distance of 3m, (iv) if it is lifted up at a constant acceleration of $1m/s^2$ by the same distance.

C5.2 A ball of 100g mass is projected up with a velocity of 20m/s. It hits a ceiling that is 10m above the point of projection. If e=3/4, determine the speed of ball as it descends to the point of projection. If the impact duration is $1/150^{th}$ of a second, determine the impulsive force.