Code No: R161111 **R16** SET - 1

I B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018
ENGINEERING MECHANICS
(Com. to CE,EEE,ME,Aero E,Auto E,Bio-Tech,Chem E, Min E,Metal E, PE, PChem E)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **FOUR** Questions from **Part-B**

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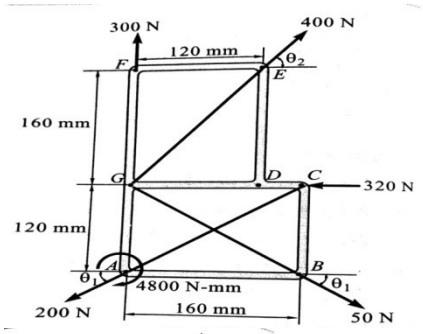
PART –A

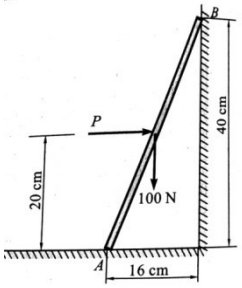
1. a) Describe the procedure to find resultant of concurrent force system. (2M)
   b) Describe the free body diagram and its importance in the analysis of problems. (2M)
   c) Differentiate between centroid and centre of gravity. (2M)
   d) Discuss the significance of Moment of Inertia? (2M)
   e) Explain (i) coefficient of friction; (ii) cone of friction. (2M)
   f) State the D-Alembert's principle. (2M)
   g) State the assumptions made while studying projectile motion. (2M)

PART -B

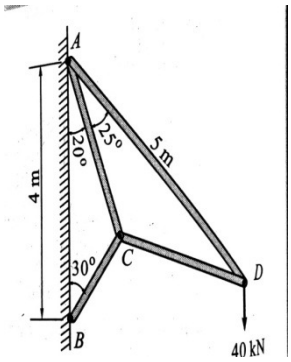
2. a) Find the resultant of coplanar forces system given in the figure and the same on AB with due consideration to the applied moment. (7M)



   b) A 100N uniform rod AB is held in the position as shown in the figure. If the coefficient of friction is 0.15 at A and B. Calculate range of values of P for which equilibrium is maintained. (7M)



3. a) Find the force and its nature in members AD and BC for given cantilever truss laoded by 40kN as shown in figure. (AB=4m and AD=5m). (7M)



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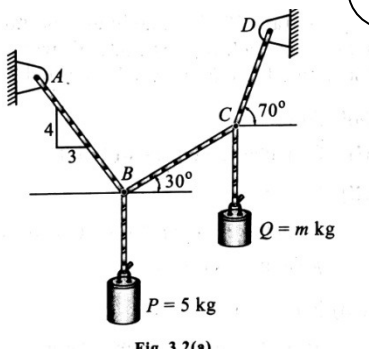
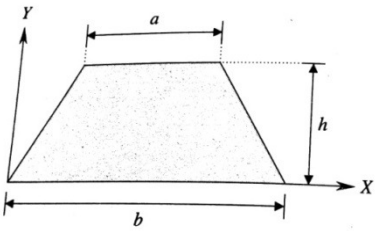
b) Block P of mass 5 kg and block Q of mass m kg is suspended through the cord is in the equilibrium position as shown in the figure. Determine the mass of block Q. (7M)

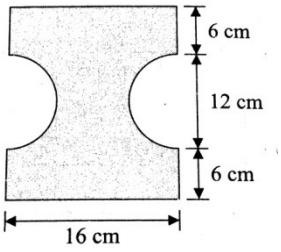


4. a) Derive the centroid of the trapezium shown in the figure. (7M)



b) Determine the centre of gravity of a solid hemisphere of radius r from its diametral axis. (7M)

5. a) Find the moments of inertia of the cut section shown about the centroidal axes. Two semicircular portions are cut from a rectangular plate. (7M)

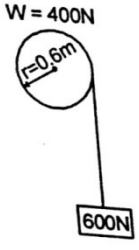


b) Determine the mass moment of inertia of a solid sphere of radius R about its diametral axis. (7M)

6. a) A cage descends a mine shaft with an acceleration of 0.6m/sec^2.After the cage has travelled 30m, a stone is dropped from the top of the shaft. Determine the time taken by the stone to hit the cage and distance travelled by the cage before impact. (7M)

b) A projectile is aimed at a target on the horizontal plane and falls 12m short when the angle of projection is 15 deg while it overshoots by 24m when the angle is 45 deg. Find the angle of projection to hit the target. (7M)

7. a) A pulley of weight 400 N has a radius of 0.6 m. A block of 600 N is suspended by a tight rope wound round the pulley, the other end being attached to the pulley as shown in figure. Determine the resulting acceleration of the weight and the tension in the rope. (7M)



b) Derive the impulse-Momentum equation of a body in motion. (7M)

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PART –A

1. a) State and describe the significance of Varignons theorem. (2M)

b) What are the conditions of equilibrium for concurrent, parallel and general force system? (2M)

c) Expalin why the first moment of an area with an axis of symmetry is zero. (2M)

d) What is the significance of Products of Inertia? (2M)

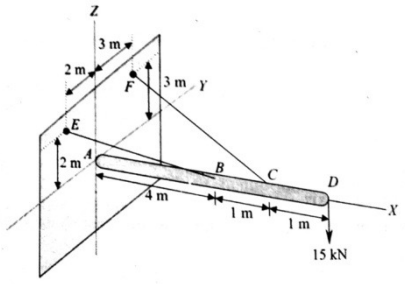
e) Define the term "Friction". What are coulomb's laws of dry friction? (2M)

f) State the law of conservation of momentum. (2M)

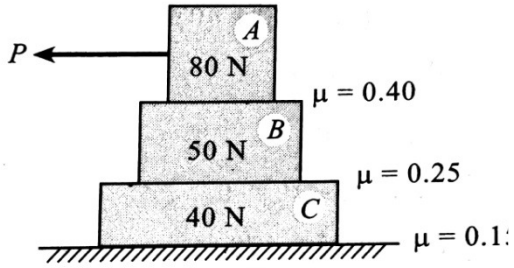
g) What are the parameters that define rectilinear motion? State the relationship between these parameters. (2M)

PART -B

2. a) A boom AD supporting a load of 15KN at the end D is held in a horizontal position by a ball and socket joint at A and by two cables BE and CF as shown. Determine the tension in each cable and the reaction at A. Neglect the weight of the boom. (7M)



b) Three blocks are placed on the surface one above the other as shown in the figure. The static coefficient of friction between the blocks and block C and surface is also shown in figure. Determine the maximum value of P that can be applied before any slipping takes place. (7M)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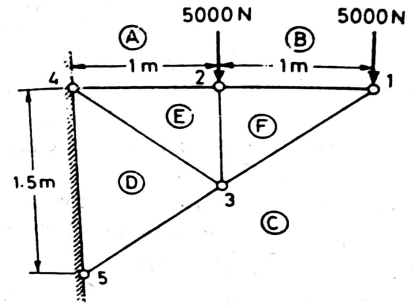
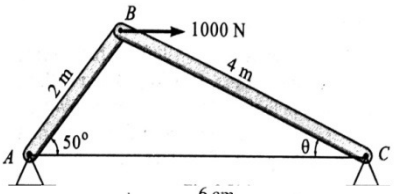
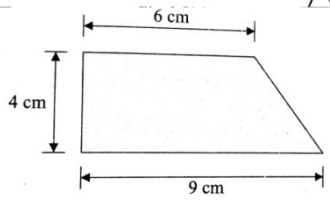
3. a) Find the forces in members B,E and F of cantilever truss loaded as shown in figure. (7M)



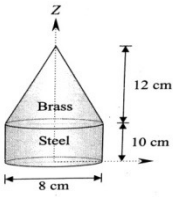
b) A frame ABC is pin joint at B and external force 1000N is applied horizontally as shown in figure. Determine the force exerted in bar AB and BC. (7M)



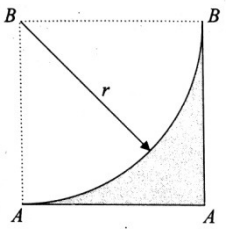
4. a) Determine the centroid of the area shown in the figure. (7M)



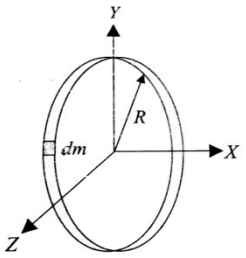
b) Determine the centre of mass of a composite body formed by placing a brass cone with a base diameter of 8 cm and 12cm height over a steel cylinder of same diameter and a height of 10 cm. Density of steel is 7850 kg/m^3 and that of brass is8650 kg/m^3. (7M)



5. a) Determine the moment of inertia of the quarter-circular spandrel shown in figure about axes AA and about BB. (7M)



b) Determine the mass moment of inertia of a circular ring of mass M and radius R about centroidal axes. (7M)



6. a) A car is moving with a velocity of 72 kmph. After seeing a child on the road the brakes are applied and the vehicle is stopped in a distance of 15 m. If the retardation produced is proportional to distance from the point where brakes are applied, find the expression for retardation. (7M)

   b) A flywheel which accelerates at uniform velocity is observed to have made 100 revolutions to increase the velocity from 120 rpm to 160 rpm. If the flywheel originally started from rest, determine the value of acceleration and time taken to increase the velocity from 120 rpm to 160 rpm. (7M)

7. a) Define work energy principle. Also derive the equation for work energy. (7M)

   b) A 320 kN gun fires a 6 kN shell horizontally with a velocity of 300m/s. What is the recoil velocity of the gun? The recoil is overcome by applying an average force of 500 kN. What is the distance travelled by the gun and the time taken? (7M)

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PART –A

1.	a)	Discuss the analytical method to find the resultant of a force system.	(2M)
	b)	State and prove Lamis theorem.	(2M)
	c)	State the pappus theorems.	(2M)
	d)	Write the Numerical formula of Polar Moment of Inertia.	(2M)
	e)	Define angle of repose.	(2M)
	f)	Define the terms momentum and Impulse.	(2M)
	g)	Define fixed-axis of rotation and give an example.	(2M)

PART -B

2. a) Block B in figure weighs 100 N. Determine the maximum weight of the block A for which the system will be in equilibrium. The coefficient of static friction between the blockB and the table is 0.20. (7M)

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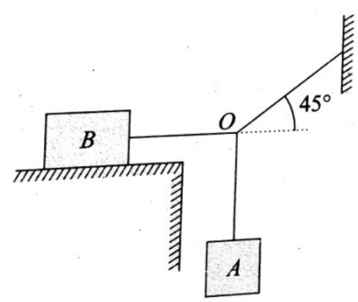
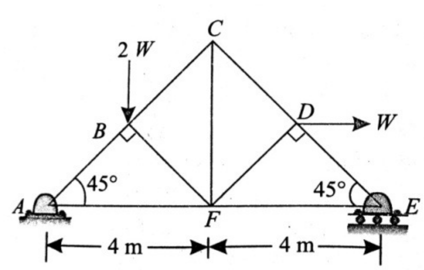


b) Forces P1,P 2,P3 and P4 of magnitude 10kN,20kN,25kN and 40kN are concurrent in space and are directed through the points A(3,2,5),B(1,7,4),C(4,-2,4) and D(-2,4,-3) respectively. Determine the resultant of the system of forces, the system of forces are concurrent at the origin. (7M)

3. a) A Truss of 8 metres span,is loaded as shown in figure. Find the forces in the members CD, FD and FE of the truss using method of sections. (7M)



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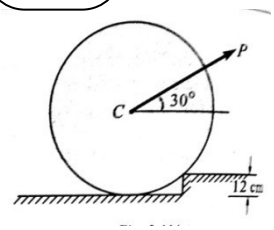
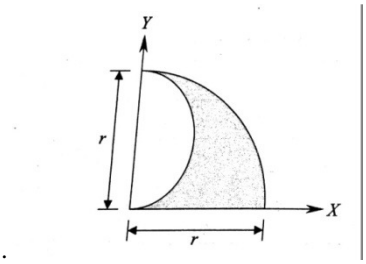
b) Determine the force P applied at 30 degree to the horizontal just necessary to start a roller having radius 50 cm over a obstruction 12 cm high, if roller is of mass 100 kg, as shown in the figure. (7M)

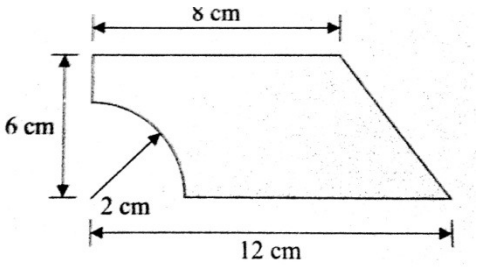


4. a) Determine the centroid of the shaded area formed by removing a semicircle of diameter r from a Quarter circle of radius r. (7M)

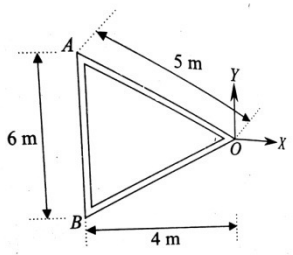


b) Locate the centre of gravity of the right circular cone of base radius r and height h. (7M)

5. a) Compute the second moment of the area shown in the figure. (7M)



b) A uniform steel rod is bent into the shape of an isosceles triangle. Compute the radius of gyration about an axis through O perpendicular to the plane of the figure. The total mass of the steel rod is 10kg. (7M)



6. a) The horizontal component of the velocity of a projectile is twice its initial vertical component. Find the range on the horizontal plane, if the projectile passes through a point 18 m horizontally and 3 m vertically about the point of projection. (7M)

b) A stone is thrown upwards from the top of a tower 70 m height with a velocity of 19.2 m/s. Determine its position and velocity when t = 6 seconds. (7M)

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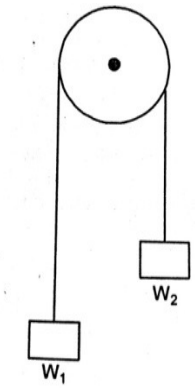
7. a) Two blocks of weight W1 and W2 are connected by inextensible wire passing over a smooth pulley as in the figure. If W1 is greater than W2,find the tension in the string and the acceleration of the system. (7M)



b) Derive the work energy equation of translation (7M)

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PART –A

1. a) State and prove the law of parallelogram of forces. (2M)

   b) Explain the types of supports and indicate the reactions they offer. (2M)

   c) State the pappus theorem-II and determine the volume of a cylinder using it. (2M)

   d) Explain the transfer formula for mass moment of inertia. (2M)

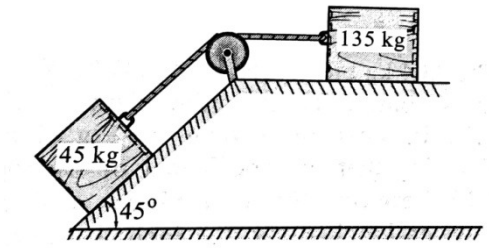
   e) Define the system of forces. Sketch the Concurrent system of forces. (2M)

   f) Find the product of inertia of a rectangle of sides a and b with respect to the axes that lie along its two sides. (2M)

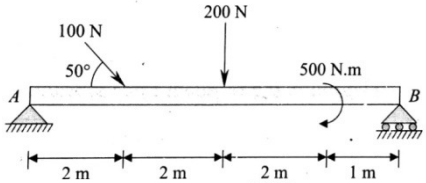
   g) Define general plane motion and give an example. (2M)

PART -B

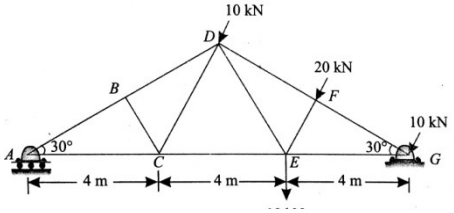
2. a) Determine the necessary force P acting parallel to the plane to cause motion to impend shown in figure. Assume coefficient of friction as 0.25 and the pulley to be smooth. (7M)



   b) In the figure shown, reduce the given system of forces acting on beam AB to an equivalent force-couple system at point A and point B. (7M)



3. a) A truss of 12 metres span is loaded as shown in figure. Determine the forces in the members BD,CE and CD of the truss. (7M)



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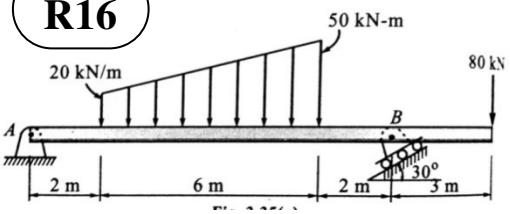
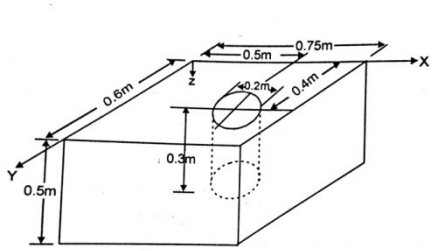
b) Find the support reactions at A and B for the beam loaded as shown in the figure. (7M)

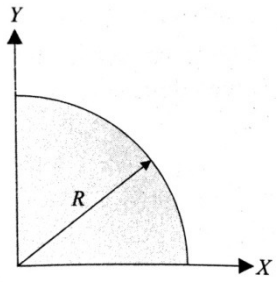


4. a) Determine the surface area and volume of a cone using the pappus and guldinus theorems. (7M)

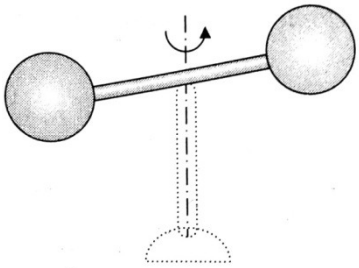
b) A concrete block of size 0.6mx0.75mx0.5m is cast with a hole of diameter 0.2 m and depth 0.3m as shown in figure. The hole is completely filled with steel balls weighing 2500 N. Locate the centre of gravity of the body. Take the weight of the concrete =25000N/m^3. (7M)



5. a) Determine the product of inertia of the quarter-circular area with respect to X and Y axes as in the given figure. (7M)



b) Determine the mass moment of inertia of the composite solid shown about the axis of rotation. The solid is made up of two identical spheres each of 2kg mass and 3cm radius attached at the end of a slender rod of 400grams mass and 15 cm length. (7M)



6. a) A bullet is fired from a height of 120 m a velocity of 360kmph at an angle of 30 degrees upwards. Neglecting air resistance find (i) total time of flight; (ii) Horizontal range of bullet. (7M)

b) Power supply is cut off to a power driven wheel when it was rotating at a speed of 900 rpm. It was observed to come to rest after making 360 revolutions. Determine its angular retardation and time it took to come to rest after power supply was cut off. (7M)

7. a) A man weighing W Newton entered a lift which moves with an acceleration of a m/sec^2.Find the force exerted by the man on the floor of lift when i) lift is moving upwards ,ii) lift is moving downwards. (7M)

b) In a police investigation of tire marks, it was concluded that a car while in motion along a straight level road skidded for a distance of 60 meters after the brakes were applied. If the coefficient of friction between the tires and the pavement is estimated as 0.6, what was the probable speed of the car just before the brakes were applied? (7M)