Code No: 153AW **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, December - 2019
ENGINEERING MECHANICS
(Electrical and Electronics Engineering)

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 as sub questions.

PART – A

(25 Marks)

1.a) State and explain polygon law of forces. [2]
b) Differentiate between static and dynamic friction. [2]
c) Define moment of inertia. [2]
d) Define potential energy. [2]
e) What do understand by kinetics of rigid body? [2]
f) Two forces act on a particle. One is doubled and the other is increased by 20N. Find the later force if the direction of the resultant remains unaltered. [3]
g) Explain the implications of center of gravity. [3]
h) State and explain the importance of radius of gyration. [3]
i) Explain the basic nature of constrained motion. [3]
j) Explain the importance of instantaneous center of rotation. [3]

PART – B

(50 Marks)

2.a) A 500N cylinder, 1 m in diameter is loaded between the cross pieces AE and BD which makes an angle of 60^0 with each other and are pinned at C and is shown in figure 1. Determine the tension in the horizontal rope DE, assuming that the cross pieces rest on a smooth floor.

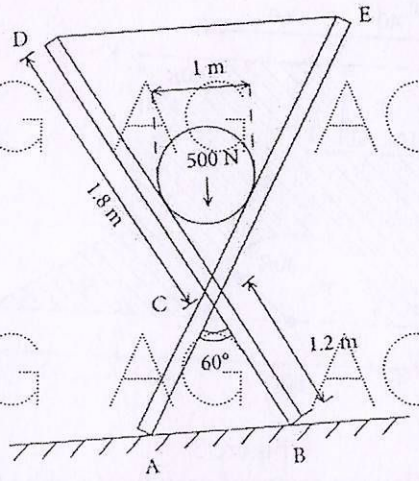

Figure 1

b) An electric light fixture weighing 20N hangs from a point C by two strings AC and BC. AC is inclined at 60^0 to the horizontal and BC is 45^0 to the vertical. End C is attached to the roof and end B is attached to the wall. Using Lami's theorem or otherwise determine the forces in the strings AC and BC. [5+5]

OR

3.a) Two cylinders A and B of weight 1000N and 500N rest on smooth inclined planes as shown in figure 2. A bar of negligible weight is hinged to each other cylinder at its geometric center by smooth pins. Determine the force P as applied can hold the system in equilibrium for give position.

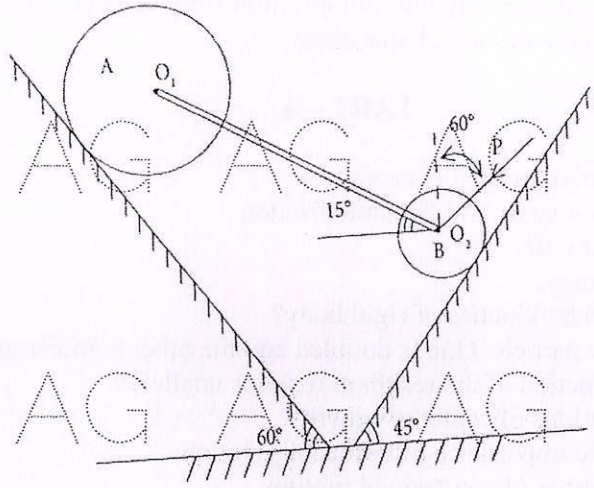

Figure 2

b) ABCD is a rectangle in which AB=CD=100mm and BC=DA=80mm. Forces of 100N each act along AB and CD and forces of 50N each act along BC and DA. Find the resultant moment to two couples. [5+5]

4.a) Find the centroid of the plane composite lamina shown in figure 3. All dimensions are in mm.

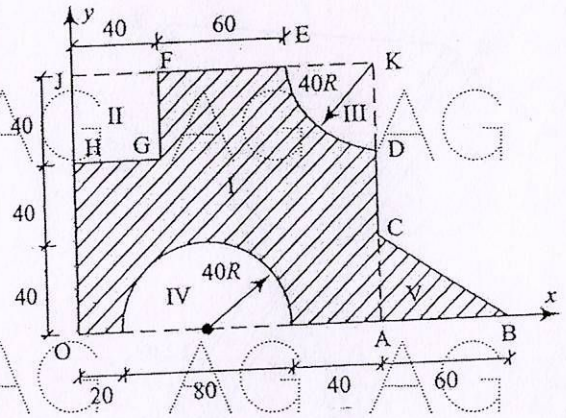

Figure 3

b) From the first principles find the center of gravity of a cube of side 20mm. [5+5]

OR

5.a) Determine by direct integration the coordinates of the centroid of the area formed by the intersection of a straight line and the curve $y=kx^2$(Figure4)

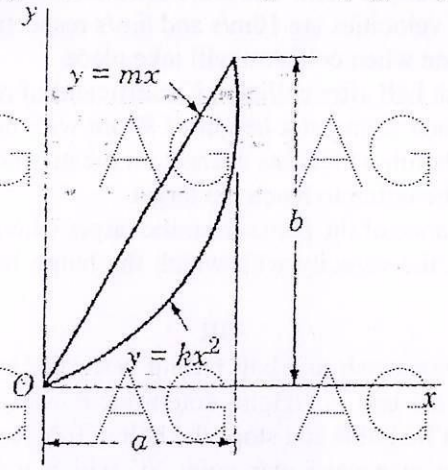

Figure 4

b) A screw jack has square threads of mean diameter 70mm and pith 10mm. If the coefficient of friction between screw and nut is 0.12, determine:
i) force to be applied at 400mm radius of jack to lift 500N load
ii) check the self locking of the jack. [5+5]

6.a) State and prove parallel axis theorem.

b) Determine the mass moment of inertia of a steel pipe with 90mm outside diameter and 72.5mm inside diameter and 3m long with respect to its longitudinal axis. The density of steel is 7830kg/m^3. [5+5]

OR

7.a) A flywheel shown in figure 5 is made of steel having density of 7830kg/m^3. What is the moment of inertia about its geometric axis? What is the radius of gyration?

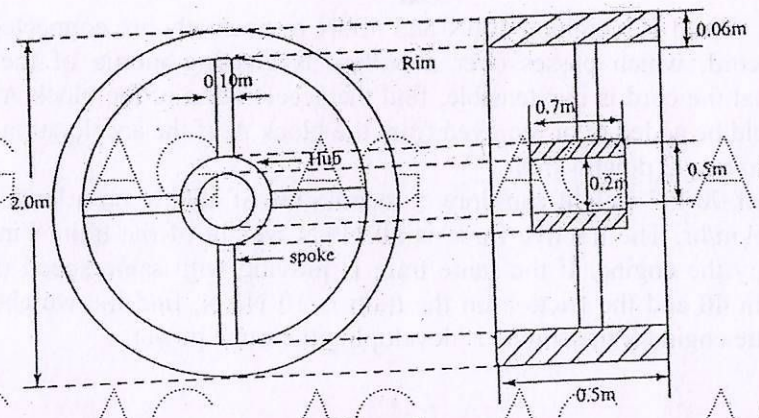

Figure 5

b) From the first principles, find the moment of inertia of a circular plate of radius 'R' about its diametral axis. [5+5]

8.a) Two smooth balls of masses 4kg and 7kg are lying on a straight smooth track. The distance between the balls is 35m. The balls start to move in the same direction and just before collision their velocities are 10m/s and 6m/s respectively. Determine:
i) the distance and time when collision will take place
ii) the velocity of each ball after collision if coefficient of restitution is 0.6.

b) A MIG-27 fighter plane flying at a height of 900m with uniform horizontal velocity of 750km/hr releases a bomb which hits a target on the ground. Determine:
i) the time taken by the bomb to reach the target
ii) the horizontal distance of the plane from the target when the bomb was released, and
iii) the direction and the velocity with which the bomb hits the target. Neglect the air resistance. [5+5]

OR

9.a) A cricket player takes a catch of a ball falling vertically under gravity from a height of 40m. If the mass of the ball is 163gm, determine the impulse force and average force borne by the player if he holds and stops the ball in 0.6seconds.

b) A bullet has a target at a particular point 'p' which is located along the horizontal ground from the point of projection of the bullet. It was found that when the angle of projection is 20^0, it falls 12m short for the target and it overshoots by 25m when the angle of projection is 35^0. Find out the correct angle of projection of the bullet if it hits the target without change of initial projection velocity. [5+5]

10.a) A man weighing 600N stands on the floor of a lift. Determine the force exerted on the floor when (i) the lift moves upward with an acceleration of $1.3m/s^2$, and (ii) the lift moves downward with an acceleration of $1.3m/s^2$ (iii) if a 700 N force is being exerted on the floor, with what acceleration is the lift moving? Solve the problem using D'Alembert's principle.

b) A bullet of 75gr mass fired with a speed of 350m/s penetrates to a depth of 12cm into a block of wood. Find the force of resistance of the block, assuming it to be uniform throughout. If the same bullet with the same speed were fired in to a similar block of 5cm thick wood, with what speed would it emerge from the block? [5+5]

OR

11.a) Two blocks A and B weighing 500N and 400N respectively are connected to the two ends of a cord, which passes over a pulley. Neglecting inertia of the pulley and assuming that the cord is inextensible, find the acceleration of the block A. How much weight should be added to or removed from the block A, if the acceleration of the block is required to be g/3 downwards?

b) An engine of 90 kN weight can draw a locomotive of 350kN on a level track with a speed of 35km/hr. The tractive force is 20 N/kN weight of the train. Find the power developed by the engine. If the same train is moving with same speed up an incline plane of 1 in 40 and the friction on the train is 10 N/kN, find the weight of the train carried by the engine if the engine is developing the same power. [5+5]

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