Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

First Semester B.Tech Degree Regular and Supplementary Examination December 2022 (2019 Scheme)

Course Code: EST 100
Course Name: ENGINEERING MECHANICS
(2019 -Scheme)

Max. Marks: 100   Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks   Marks

1	Explain principle of transmissibility	(3)
2	Explain free body diagram	(3)
3	Define angle of friction and angle of repose. Establish the relation between them	(3)
4	State the laws of friction	(3)
5	Write the formula for moment of inertia of a semi-circle about the centroidal axis parallel to the base and hence derive the formula for MI about an axis through its base.	(3)
6	A force $F = 2i + 4j - 3k$ is applied at a point A (1,1, -2). Find the moment of the force about the point B(2,-1,2).	(3)
7	A lift has upward acceleration of 1.225 m/s^2. What pressure will a man weighing 500N exert on the floor of the lift. What will be the pressure when the lift is moving with same acceleration in the downward direction.	(3)
8	State and explain D' Alembert's principle	(3)
9	Explain instantaneous centre of zero velocity	(3)
10	A wheel rotating about a fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which it makes 50 revolutions. Find the angular velocity at the end of this interval.	(3)

PART B

Answer one full question from each module, each question carries 14 marks.

MODULE 1

11 a A string ABCDE whose end A is fixed has weights W_1 and W_2 attached to it at   (9)
B and C, and pass over a smooth peg at D carrying a weight of 1000 N at the
free end E, as shown in the Fig.1. In the equilibrium position BC makes an

angle of 20^0 with the horizontal and AB and CD make angles of 150^0 and 120^0 respectively with BC. Determine:

    i)   The tensions in portion AB, BC, CD and DE.

    ii)   The values of weights W_1 and W_2.

Fig.1

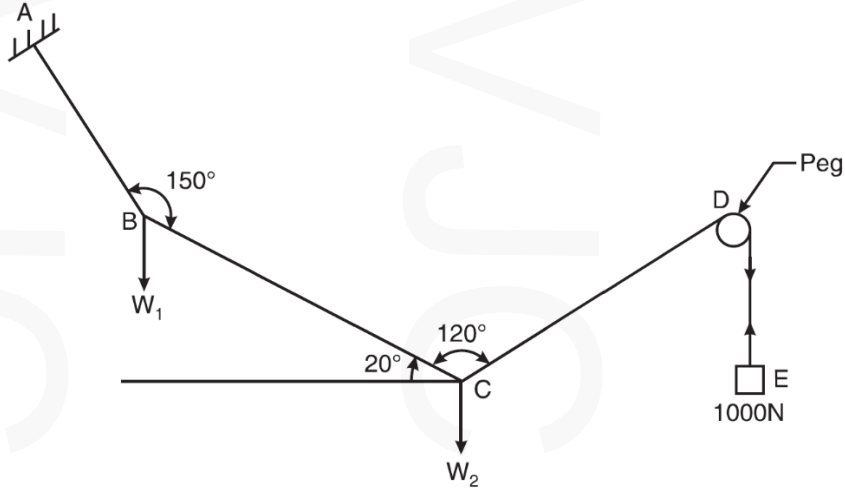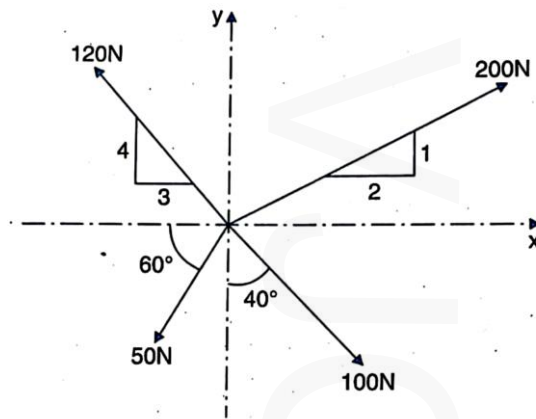b   (5)

Fig.2

Four forces are acting at a point as shown in the Fig.2. Find the resultant

12 a Two spheres, each of weight 1000N and radius 25 cm rest in a horizontal channel of width 90cm as shown in the Fig.3. Find the reactions on the point of contacts A, B and C.   (9)
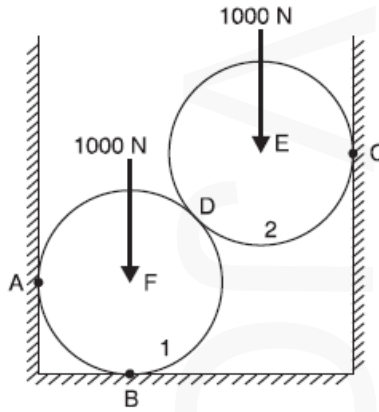

Fig.3

  b Five forces are acting at an angular point of a regular hexagon towards other angular points as shown in the Fig.4. Calculate the moment of these forces about the point A.   5
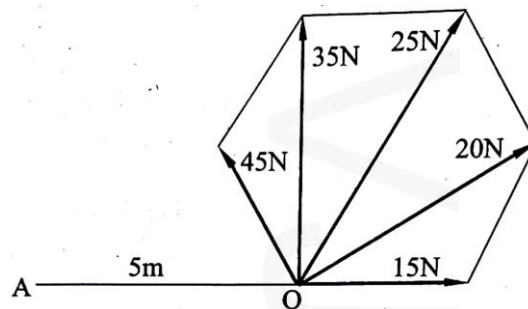

Fig.4

MODULE 2

13 a ABCD is a square, each side being 20 cm and E is the middle point of AB. Forces of 7, 8, 12, 5, 9 and 6N act on the lines of directions AB, EC, BC, BD, CA and DE respectively. Find the magnitude and direction of the resultant. Also find the position of the resultant force from E.   (9)

  b   (5)

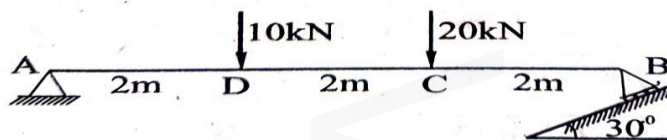Fig.5

For the beam shown in the Fig.5 find the support reactions

14 a A uniform ladder 6m long weighing 300N is resting against a wall with which   (7)

it makes 30^0. A man weighing 750N climbs up the ladder. At what position along the ladder from the bottom end does the ladder slips. The coefficient of friction for both the wall and the ground with ladder is 0.2.

b

15 N   50 N   10 N   20 N   7

A   C   D   B

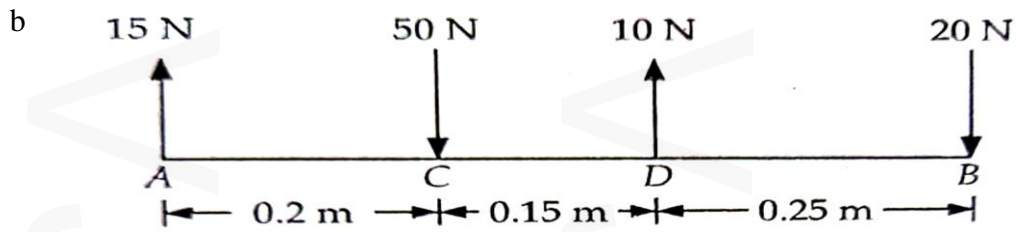|← 0.2 m →|← 0.15 m →|← 0.25 m →|

Fig.6

A rigid bar is subjected to a system of parallel forces as shown in the Fig.6. Reduce the system into (i) A single force moment system at A (ii) A single force moment system at B.
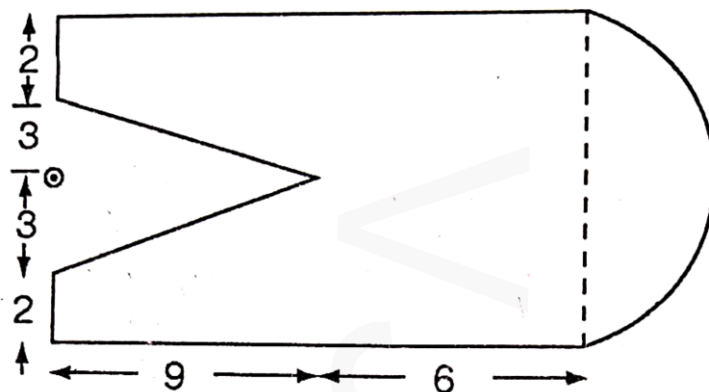
MODULE 3

15   (14)

Fig.7

Find the moment of inertia of the given lamina as shown in the Fig.7 about the centroidal axis. All dimensions are in cm.

16   (14)

y

P (0, 10, 0)

A (− 3, 0, − 4) C (5, 0, 1)

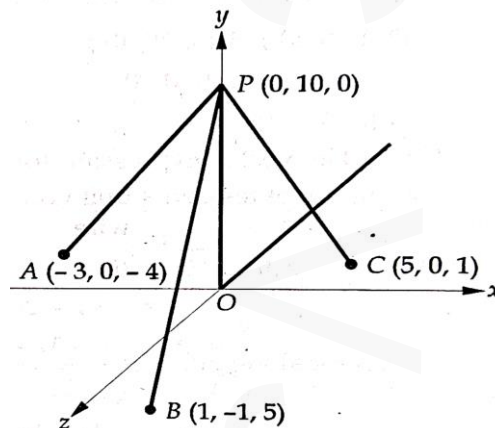O x

B (1, −1, 5)

z

Fig.8

A vertical post is supported by three cables PA, PB and PC and tied at a common point P, 10m above the ground as shown in the Fig.8. The base points of cables are A(-3,0,-4), B(1,-1,5) and C(5,0,-1). If the tensile forces in PA, PB and PC are 15kN, 18kN and 20kN respectively, find the resultant force on the post at P.

MODULE 4

17 a An automobile enters a curved road at 30 km/hr and then leaves at 48 km/hr. The curved road is in the form of quarter of a circle and has a length of 400m. If the car travels at constant tangential acceleration along the curve, calculate the resultant acceleration at both ends of the curve. (8)

   b The equation of motion of a particle along a straight line is given by (6)

   $S = 18t + 3t^2 - 2t^3$

   Where s is the distance travelled from starting point is in meters at the end of t seconds. Find

   (i)   The velocity and acceleration at the starting

   (ii)   The time when the particle reaches maximum velocity

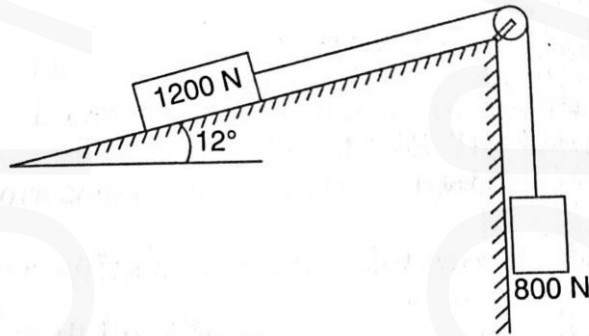   (iii)   The maximum velocity of the particle

18 a (9)

Fig.9

A body of weight 1200N rest upon a rough inclined plane at 12^0 to the horizontal. It is pulled up the plane by means of a light flexible rope running parallel to the plane and passing over a light frictionless pulley at the top of the plane as shown in the Fig.9. The portion of the rope beyond the pulley hangs vertically down and carries a weight of 800N at its end. If the coefficient of for the plane and the body is 0.2, find

   (i)   Tension in the rope

   (ii)   Acceleration with which the body moves up the plane

(iii) The distance moved by the body in 3seconds after starting from rest

b A projectile is aimed at a mark on the horizontal plane through the point of projection and falls 12m short when the angle of projection is 15^0 while it overshoots the mark by 24m when the angle of projection is 45^0. Find the angle of projection required to hit the mark. (5)

MODULE 5

19 A wheel accelerates from rest to a speed of 180 rpm uniformly in 0.4 seconds. It then rotates at that speed for 2s and then decelerates and come to rest in 0.3s. Determine the total revolutions made by the wheel. (14)

20 a A particle is moving with simple harmonic motion and has velocities of 8m/s and 3m/s at a distance of 1.5m and 2.5m respectively from the mean position. Find the amplitude and time period of the motion. (9)

b A spring is fixed at its upper end and carries a mass of 5kg attached to it at its lower end. The mass is set into vibration and is measured to make 2 oscillations/s. Calculate the stiffness of the spring (5)

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