00EST100121904
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
Second Semester B.Tech Degree Examination July 2021 (2019 scheme)

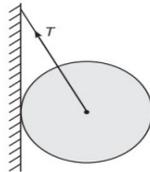## Course Code: EST100
Course Name: ENGINEERING MECHANICS
## (2019 Scheme)

Max. Marks: 100   Duration: 3 Hours

PART A
*(Answer all questions, each carries 3 marks.)*

1	Define free body diagram. Draw free body diagram of a spherical ball of weight W supported by a string and resting against a wall as shown in figure.	(3)

2	State and explain Lami's theorem.	(3)
3	Weights 60N and 80N are suspended at the ends A and B respectively, of a uniform beam AB of weight 100 N and 6m long. At what distance from A the beam should be supported so that it remains horizontal.	(3)
4	A system of parallel forces is acting on a rigid bar as shown. Reduce this system to a single force.	(3)
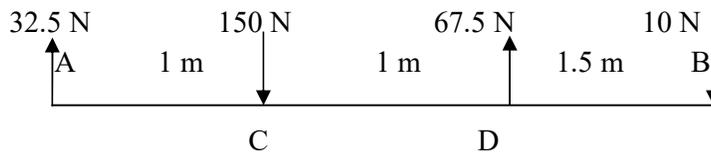
5	State Pappus Guldinus theorems.	(3)
6	Find the centroid of the T section shown,	(3)
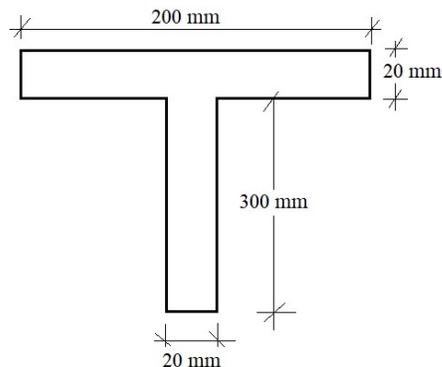
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7	A block of mass 10 kg is suspended by an inextensible string passing over a smooth frictionless pulley. If the mass is pulled up at an acceleration of 1 m/s^2, calculate the tension in the string.	(3)

8   Calculate the increase in reaction under the feet of person of weight 600 N in a   (3)
lift, if the lift accelerates upward with an acceleration $1m/s^2$.

9   A body moving with simple harmonic motion, has an amplitude of 1m and   (3)
period of oscillation is 2 seconds. Find the velocity and acceleration of the body
at $t = 0.4$ second, when time is measured from the mean position.

10   Explain concept of instantaneous centre. Also state its significance.   (3)

PART B
(Answer one full question from each module, each question carries 14 marks)
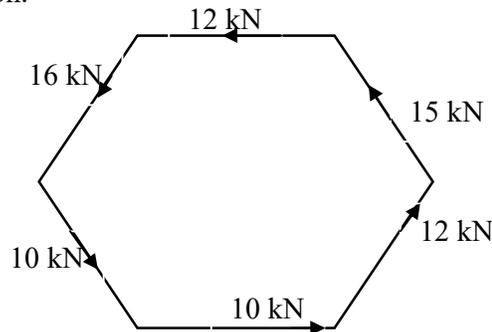### Module-I

11   A roller of radius 300 mm and weight 1000N is to be pulled over a rectangular   (14)
block of height 150mm as shown in fig. Determine (i) the horizontal force
required to be applied through the centre and (ii) the required horizontal force
when it is applied through the top end of vertical diameter.
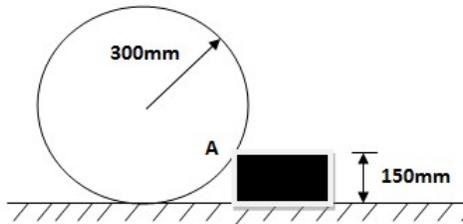
12   a)   A block P= 5kg and block Q of mass M kg are suspended through a chord which   (5)
is in equilibrium as shown in Fig. Determine the mass of the block Q.
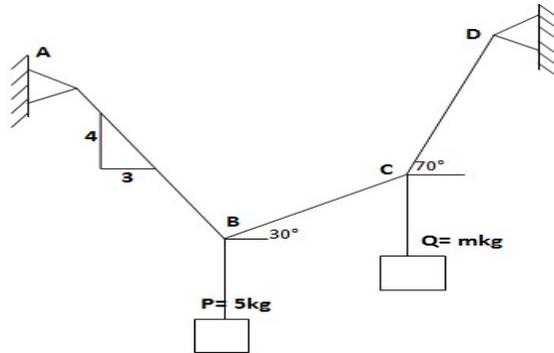

     b)   Six forces of magnitude 10 kN, 12 kN, 15 kN, 12 kN, 16 kN, and 10 kN are   (9)
acting along the sides of the regular hexagon of side 2 m in order. Find the
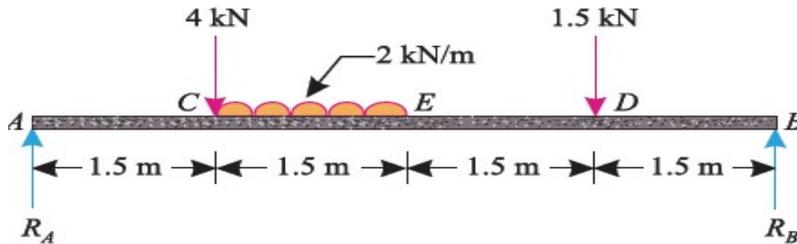resultant force and its direction.

Module-II

13 a) A square ABCD has forces acting along its sides as shown in figure below. (6)
Find the values of P and Q, if the system reduces to a couple. Also find
magnitude of the couple if the side of the square is 1m.
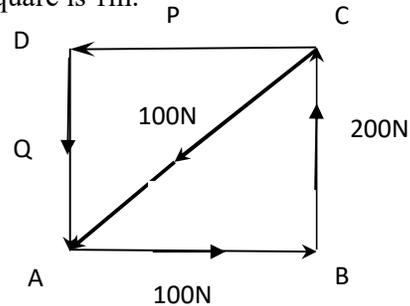
b) A simply supported beam AB of span 6m is loaded as shown in figure. (8)
Determine the reactions at A and B.

14 a) A rough inclined plane, rises 1 cm for every 5 cm along the inclined length. (5)
Calculate the effort required to drag a body weighing 100 N up the plane, when
the effort is applied parallel to the plane ($\mu = 0.25$)

b) A uniform ladder weighing 300N is resting against a wall with which it makes (9)
30° with the vertical. 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 is 0.20.

Module-III

15 The cross section of a cast iron beam is shown in figure. Determine the (14)
moments of inertia of the section about the horizontal and vertical axes passing
through the centroid.
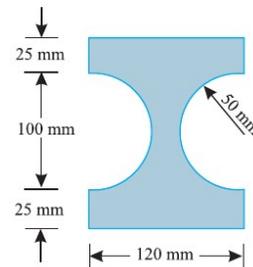
16 A post is held in vertical position by three cables AB, AC and AD as shown in (14)
figure. If the tension in cable AB is 40 N, calculate the tension in AC and AD, so
that the resultant of three forces at A is vertical.
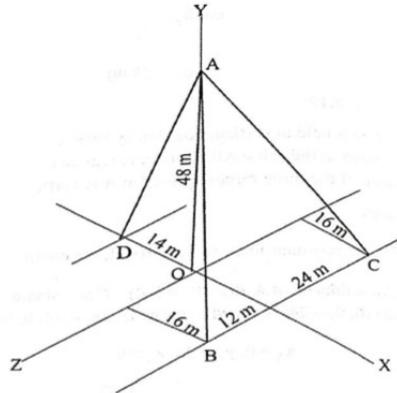
Module-IV

17 a) In the motion of a projectile, in what proportion will the maximum range be increased if the initial velocity is increased by 10%? (5)

b) A train weighing 1700 kN without the engine starts to move with constant acceleration along a straight horizontal track and in the first 60 seconds acquires a velocity of 54 km/hr. Determine the tension in the coupling between the train and the engine if the total resistance to motion due to friction and air resistance is constant and equal to 0.005 times the weight of the train. (9)

18 a) A ball of mass 'm' is dropped from rest from the top of a tower of height H. Write the equations of kinematics for the motion of the ball under free fall at any instant 't' of the motion. (4)

b) Three spherical balls of mass 2kg, 6kg and 12kg are moving in the same direction with velocities 12m/s, 4 m/s and 2 m/s respectively. If the ball of mass 2 kg impinges with the ball of mass 6kg, which in turn impinges with the ball of mass 12kg, prove that the balls of masses 2kg and 6kg will be brought to rest by the impacts. Assume to be perfectly elastic. (10)

Module-V

19 An inextensible rope passing over a smooth pulley has two blocks of mass 20 kg and 30 kg attached to its two ends. The mass of the pulley is 10 kg and radius of gyration 0.3m. Determine the tension on the rope and the acceleration of the masses. (14)

20 In a particular SHM performed by a particle of mass m, the amplitude is 1.57m and time period of oscillation is 5s. i) Calculate velocity and acceleration of particle at 0.53m away from centre ii) Determine magnitude and location of maximum velocity and maximum acceleration of particle iii) Also determine the time required by the particle to pass two points 1.35 m away and 0.53 m away from the central point of oscillation. Both the points lie on the same side of the central point. (14)

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