

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Second Semester B.Tech Degree Examination June 2022 (2019 scheme)



Course Code: EST100

Course Name: ENGINEERING MECHANICS

(2019 -Scheme)

Max. Marks: 100

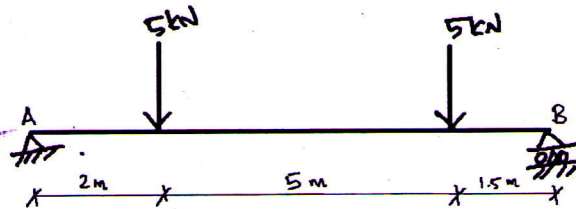
Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

Marks

- 1 State and prove Varignon's theorem of moments. (3)
- 2 Find the magnitude of the two forces, such that if they act at right angles, their resultant is $\sqrt{10}$ N. But if they act at 60° , their resultant is $\sqrt{13}$ N. (3)
- 3 A block weighing 1500 N, overlying a 10° wedge on a horizontal floor and leaning against a vertical wall, is to be raised by applying a horizontal force to the wedge. Assuming the coefficient of friction between all the surfaces in contact to be 0.3. Draw the free body diagram of the wedge and the block. (3)
- 4 A beam AB 8.5 m long is hinged at A and supported on rollers over B. Calculate reactions at A & B. (3)



- 5 State and prove perpendicular axis theorem. (3)
- 6 A force of magnitude 44 N acts through a point A (4,-1,7) in the direction of vector $9\mathbf{i} + 6\mathbf{j} - 2\mathbf{k}$. Find the moment of the force about the point B (1,-3,2). (3)
- 7 The equations of motion of a particle moving in a straight line is given by $s = 20t + 5t^2 - 3t^3$ where s is in metres and t in seconds. Find the velocity and acceleration at the start. (3)
- 8 State and explain D'Alembert's principle. (3)

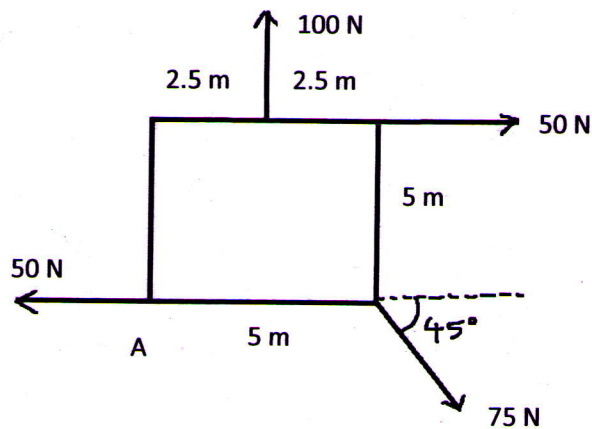
9. A flywheel of mass 5 tonne starts from rest and gets up a speed of 150 rpm in 3 minutes. Find the average torque exerted on it if the radius of gyration of wheel is 50 cm. (3)
10. Distinguish between simple harmonic motion and periodic motion. (3)

PART B

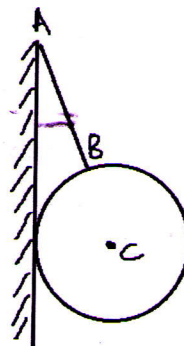
Answer one full question from each module, each question carries 14 marks.

MODULE 1

- 11 a For the system of forces, determine the magnitude, direction and position of the resultant force about A. (7)

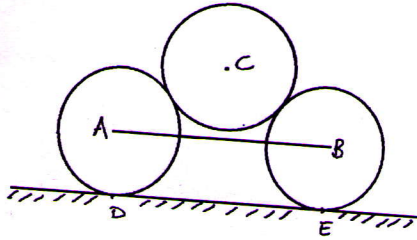


- b A smooth sphere of weight W is supported by a string fastened to a point A on the smooth vertical wall, the other end is in contact with point B as shown in figure. If length of the string AC is equal to twice the radius of the sphere, find tension (T) in the string and reaction of the wall. (7)



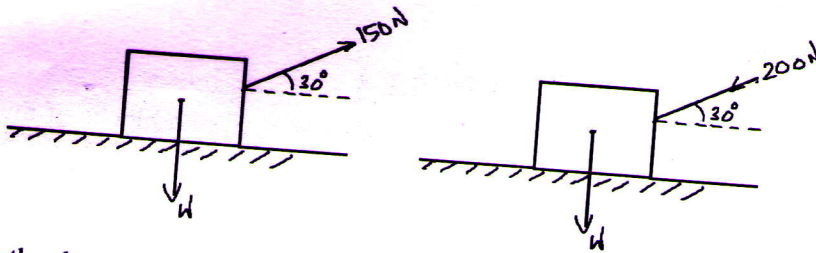
- 12 Two smooth circular cylinders each of weight 50N and radius 20 cm are connected at their centres by a string AB of length 40 cm and rest upon a horizontal plane as shown in figure. The cylinder above them has a weight of (14)

100N and radius of 20 cm. Find the force in the string AB and pressure produced in the floor at the points of contact D and E.

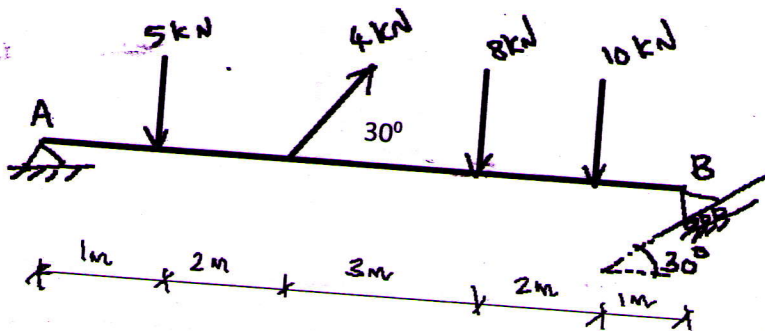


MODULE 2

- 13 a A body, resting on a rough horizontal plane, required a pull of 150 N inclined at 30° to the plane just to move it. It was found that a push of 200 N inclined at 30° to the plane just moved the body. Determine the weight of the body and the coefficient of friction. (9)



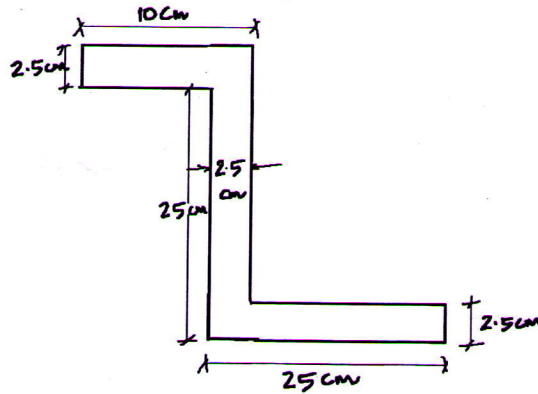
- b For the beam with loading shown in figure, determine the reactions at the support. (5)



- 14 A uniform ladder of 4 m length rests against a vertical wall with which it makes an angle of 45° . The coefficient of friction between the ladder and the wall is 0.4 and that between ladder and the floor is 0.5. At what position along the ladder from the bottom end does the ladder slips, if a man, whose weight is one-half of that of the ladder, ascends it. (14)

MODULE 3

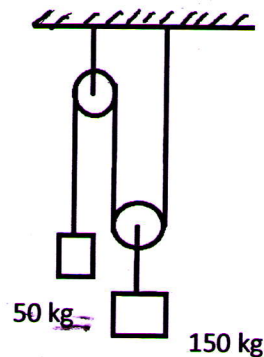
- 15 Find the centroid of the cross-sectional area of a Z section shown in figure. (14)



- 16 A force Q is directed from a point $A(4,1,4)$ metres towards a point $B(-3,4,1)$ metres. Determine the moment of force P about x and y axis if it produces a moment of 1000Nm about z axis. (14)

MODULE 4

- 17 Determine the tension in the strings and accelerations of two blocks of mass 150 kg and 50 kg connected by a string and a frictionless and weightless pulley as shown in figure. (14)



- 18 An aeroplane is flying at a height of 200m with horizontal velocity of 70 m/s . A shot is fired from a gun from the ground when aeroplane is exactly above the gun. What should be the minimum initial velocity of the shot and angle of elevation in order to hit the aeroplane. (14)

MODULE 5

- 19 A flywheel rotates for 5 s with a constant angular acceleration and describes during that time 100 rad . Then it rotates with constant angular velocity and (14)

during the next 5 s describes 80 rad. Find the initial angular velocity and angular acceleration.

- 20 A flywheel is made of steel ring 30mm thick & 300 mm wide plate with mean (14) diameter of 1.5m. If initially the flywheel is rotating at 250 rpm, find the time taken by the wheel in coming to rest due to frictional couple of 150 Nm. Take mass density of steel as 7900 kg/m^3 . Neglect the effect of spokes.
