Register No.: .... Name: ....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER B.TECH DEGREE EXAMINATION (R,S), DECEMBER 2023

(2020 SCHEME)

Course Code: **20EST100**

Course Name: **Engineering Mechanics**

Max. Marks: **100** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. State and explain principle of transmissibility. State its limitations.
2. Explain the conditions of equilibrium of coplanar concurrent force system.
3. A simply supported beam AB of span 4m is carrying point loads 10N, 6N and 4N at 1m, 2m and 3m respectively from support A. Calculate the reactions at supports A and B.
4. Define co-efficient of friction and angle of friction. Establish a relation between them.
5. A force 2i+4j-3k is applied at the point A (1,1,-2). Find the moment of the force about the point (2,-1,2)
6. State Pappus Guldinus theorems.
7. A horizontal force of 400N acts on a body of weight 480N. Find the acceleration of the body using D'Alembert's principle.
8. The position of a particle moving along a straight line is defined by the relation
   $x = t^3 - 3t^2 - 9t + 12$
   Determine the time taken by the particle when its velocity becomes zero.
9. What do you mean by instantaneous centre of rotation? How can it be located?
10. Distinguish between damped and undamped free vibrations.

PART B

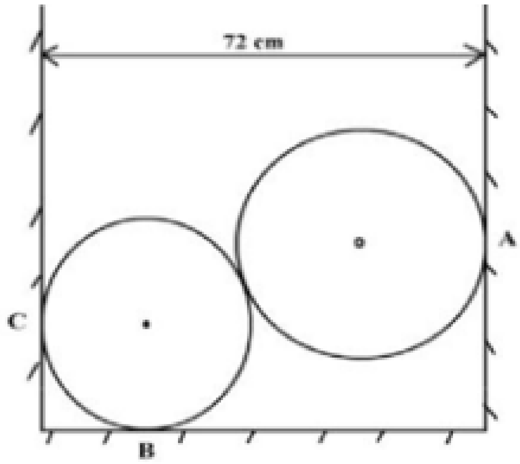
(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) A rope 9m long is connected at A and B, two points on the same level, 8m apart. A load of 300N is suspended from a point C on the rope, 3m from A. What load connected to a point D on the rope, 2m from B is necessary to keep portion CD parallel to AB. (6)

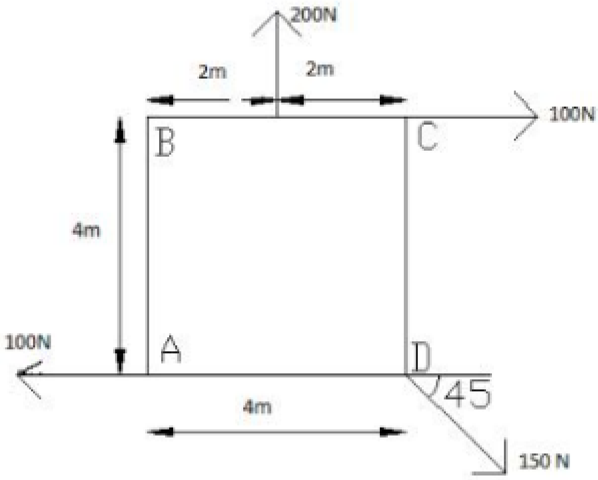
    b) Two homogeneous spherical balls rest between two vertical walls as shown in figure. The radius of smaller ball is 16 cm and its weight is 1.15kN. The radius of the larger ball is 24 cm and its (8)

weight is 3.45kN. The distance between the walls is 72cm. Assuming the contact surfaces to be smooth,
(i) Draw the free body diagram of two balls.
(ii) Determine the reactions at A, B and C.



OR

12. a) For the system of forces, determine the magnitude, direction and position of the resultant force about A. (9)



b) State and explain Varignon's theorem of moments. (5)

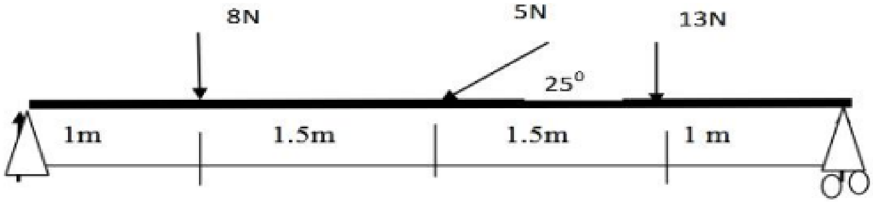
MODULE II

13. A uniform ladder 4m long weighs 200N. It is placed against a wall making an angle of 60° with the floor. The coefficient of friction between the wall and the ladder is 0.25 and that between the ground and the ladder is 0.35. The ladder in addition to its own weight, has to support a man of 1000 N at the top at B. (14)

(i) Calculate the horizontal force P to be applied to the ladder at the ground level to prevent slipping.
(ii) If the force P is not applied, what should be the minimum inclination of the ladder with the horizontal, so that it does not slip with the man at the top?

OR

14. a) Find the support reactions of the given beam. (7)



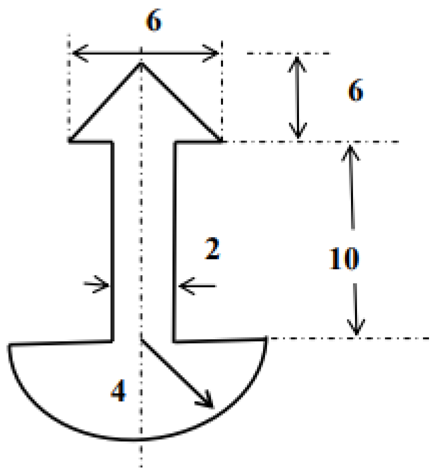
b) Find the force required to move a load of 30N up a rough inclined plane, applied parallel to the plane. The inclination of the plane is such that when the same body is kept on a perfectly smooth plane inclined at an angle, a force of 6N applied at an inclination of 30^0 to the plane keeps the same in equilibrium. Assume coefficient of friction between the rough plane and the load is equal to 0.3. (7)

MODULE III

15. A force P 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 axes, if it produces a moment of 1000Nm about Z axis. (14)

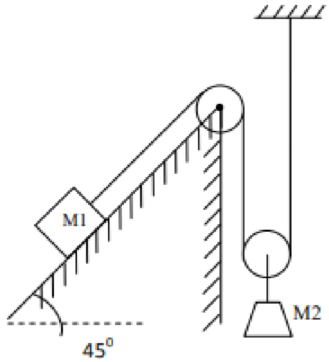
OR

16. Find the moment of inertia of area about the horizontal and vertical centroidal axes. All dimensions are in cm. (14)



MODULE IV

17. a) A block of mass M1 resting on an inclined plane is connected by a string and pulleys to another block of mass M2 as shown in figure. Find the tension in the string and acceleration of the blocks. Assume the coefficient of friction between the blocks M1 and the plane to be 0.2. M1 =1500N, M2 = 1000N. (9)
Angle of inclined plane = 45^0.



b) State and explain Work –Energy principle in dynamics. (5)

OR

18. a) The acceleration of a moving body starting from rest and moving along a straight line is given by, a= $8-\frac{t^2}{5}$ where **'a'** is in m/s^2 and **'t'** is in seconds. (9)

Determine

(i) velocity attained by the body and the distance travelled after 10 seconds.

(ii) when will the particle come to rest again and what distance will it travel by then.

b) A man weighing 850N gets into a lift. Calculate the force exerted by him on the floor of the lift, when it is (5)

i) moving upwards with an acceleration of 4m/s^2.

ii) moving downwards with an acceleration of 3m/s^2.

MODULE V

19. a) A spring stretches by 0.015m when a 1.75kg object is suspended from its end. How much mass should be attached to the spring so that its frequency of vibration is 3Hz. (5)

b) A clock provided with a seconds pendulum is gaining 160 seconds a day. Find by how much the length of the pendulum should be increased so as to correct the clock. If it is running at correct time at a place where acceleration due to gravity is 9.81m/s^2, find by how much the clock will lose or gain if it is taken to a place where the acceleration due to gravity is 9.79m/s^2. (9)

OR

20. a) A flywheel rotates with a constant retardation due to braking. In the first 10 seconds, it made 300 revolutions. At t = 7.5 seconds, its angular velocity was 40π rad/s. (7)

Determine

(i) the value of constant retardation

(ii) the total time taken to come to rest

(iii) the total revolutions made till it comes to rest

b) A particle moving with simple harmonic motion has velocities 8m/s and 4m/s when at the distance of 1m and 2m from the mean position. (7)

Determine

(i) amplitude

(ii) period

(iii) maximum velocity, and

(iv) maximum acceleration of the particle.

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