

Code No: 121AC

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech I Year Examinations, May/June - 2017

ENGINEERING MECHANICS

(Common to CE, ME, MCT, MMT, AE, AME, MIE, PTM, CEE, MSNT)

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, c as sub questions.

Illustrate your answer with NEAT sketches wherever necessary

Part- A (25 Marks)

- 1.a) Write the equations of equilibrium for a system of Coplanar Concurrent Forces in terms of moments. [2]
- b) What is a Free Body diagram? Explain with the help of figures. [3]
- c) What is 'Slip' of the belt in a belt drive? What is its effect on the velocity ratio of the drive? [2]
- d) What is a Wedge? Deduce an expression for its efficiency. [3]
- e) What is Radius of gyration? Explain. [2]
- f) Explain the terms 'Product of Inertia' and 'Principal axes. [3]
- g) Write the differential equation of motion of Rectilinear motion, and explain it. [2]
- h) Explain briefly about the Kinematics of Rotational Motion around a Fixed Axis. [3]
- i) State the Principle of Conservation of Momentum. [2]
- j) Distinguish between Simple and Compound Pendulums. [3]

Part-B (50 Marks)

- 2.a) Determine the axial force induced in each bar of the system shown in figure 1 due to the action of the applied forces P .

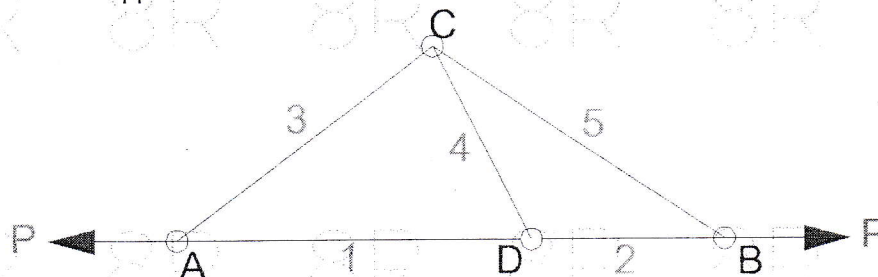


Figure: 1

- b) State and prove the Theorem of Varignon.

[5+5]

OR

- 3.a) A prismatic bar AB of weight $Q = 17.8 \text{ kN}$ is hinged to a vertical wall at A and supported at B by a cable BC, as shown in figure 2. Determine the magnitude and direction of the reaction R_a at the hinge A and the tensile force F in the cable BC.

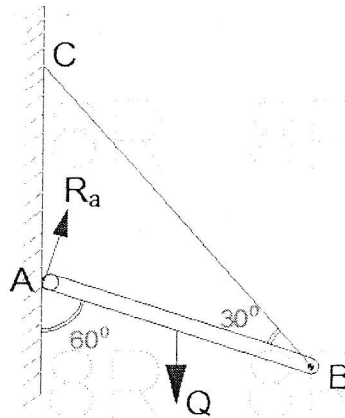


Figure: 2

- b) Differentiate between the moment of a force and couple. [5+5]
4. In a screw – jack, where the helix angle of thread is α and the angle of friction is ϕ , W is the load to be moved up / down, and P is the effort applied horizontally to a lever at a distance L from the axis of the screw, discuss the effects of moving the load (a) up and (b) down, if (i) $\phi < \alpha$, and (ii) $\phi > \alpha$ in each case. [10]
- OR
- 5.a) What is 'Initial tension' in a belt drive? If T_0 is the initial tension, derive the expression $\frac{T_1 - T_0}{T_2 - T_0} = e^{\mu\theta}$, with usual notation of the terms in the expression.
- b) Prove that the angle of friction is equal to the angle of the inclined plane, when a solid body of weight W placed on the inclined plane, is about to slide down. [5+5]
6. Determine the moments of inertia and the radius of gyration of the area, shown in figure 3, with respect to the x and y axes. (All dimensions are in mm). [10]

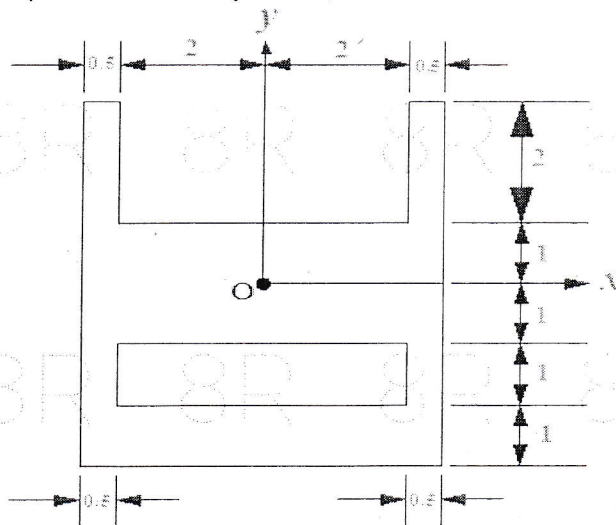


Figure: 3

OR

7. Determine the centroid of a hemisphere of radius R . [10]

- 8.a) A particle starts from rest and moves along a straight line with constant acceleration a . If it acquires a velocity $v = 3$ m/s after having travelled a distance of $s = 7.5$ m, find the magnitude of the acceleration.
- b) Write the equations of plane motion of a rigid body. [5+5]

OR

- 9.a) A solid circular cylinder and a sphere are started from rest from the top of an inclined plane at the same time, and both roll without sliding down the plane. When the sphere reaches the bottom of the incline, if the cylinder is 3.6 m behind it, what is the total length of the inclined plane?
- b) What are the different types of rigid body motion? Explain. [5+5]

- 10.a) The driver of an automobile moving with a constant speed $v_0 = 64$ kmph along a straight level road steps on the accelerator so as to increase the power by 20 percent. How far will the car travel before attaining a speed of 80 kmph? Assume that the resistance to motion remains constant and equal to 5% of the weight of the car.

- b) What do you mean by period of vibration, cycle, frequency and resonance as applied to vibratory motions? Explain. [5+5]

OR

- 11.a) Define Impulse and Momentum, and derive their expressions from the differential equation of rectilinear motion of a particle.
- b) In a spring – mass vibrating system, the natural frequency of vibration is 3.56 Hz. When the amount of suspended mass is increased by 5 kg, the natural frequency is lowered to 2.9 Hz. Determine the original unknown mass and the spring constant. [5+5]

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