KALAIVANI COLLEGE OF TECHNOLOGY
MODEL EXAMINATION
Second Semester
ENGINEERING MECHANICS

Time : Three Hours Max. Marks : 100

PART – A (20 X 2 = 40 Marks)

Answer **ALL** Questions

1. Draw the various systems of forces.
2. State Lame's Theorem.
3. What is a couple? Write its properties.
4. Mention any four types of beams.
5. State the theorems of Pappus and Guldinus to find out the surface area and the volume of a body.
6. What is polar moment of inertia?
7. What is curvilinear motion?
8. Define the term 'coefficient of restitution' of two bodies under impact.
9. State Coulomb's laws of dry friction.
10. What do you mean by coriolis acceleration?
11. Determine the resultant of the three forces $F_1 = 2.0\mathbf{i} + 3.3\mathbf{j} - 2.6\mathbf{k}$; $F_2 = -\mathbf{i} + 5.2\mathbf{j} - 2.9\mathbf{k}$; and $F_3 = 8.3\mathbf{i} - 6.6\mathbf{j} + 5.8\mathbf{k}$, which are concurrent at the point (2, 2, -5.). The forces are in newtons and the distances are in metres.S
12. A force F = (6N)**i** – (3N**j** – (4N)**k** is acting at a point P whose position vector from the origin 'O' of the coordinate axes is (8 mm)**i** + (6 mm)**j** – (4 mm)**k**. Find the moment of the force about the origin.
13. A belt embraces an angle of 200° over the surface of a pulley of 500 mm diameter. If the tight side tension of the belt is 2.5 kN. Find out the slack side tension of the belt. The coefficient of friction between the belt and the pulley can be taken as 0.3.
14. Calculate the resultant of two concurrent forces 20 N each at right angles.
15. Find the moment contributed by a couple 75 KN force with an arm of 4 m.

16. The motion of a particle in defined by the relation $x = t^3 - 15\ t^2 - 20$, where 'x' is expressed in metres and 't' in seconds. Determine the acceleration of the particle at t = 3 seconds.

17. A mass of 50 kg. has an initial velocity of 15 m/s. horizontally on a smooth surface. Determine the value of horizontal force that will bring the mass to rest in 4 seconds.

18. Calculate the centroid of a right angled triangle of base 20 mm and height 33 mm.

19. Locate the centroid of a T Section whose web and flange are of size 100 mm x 10 mm.

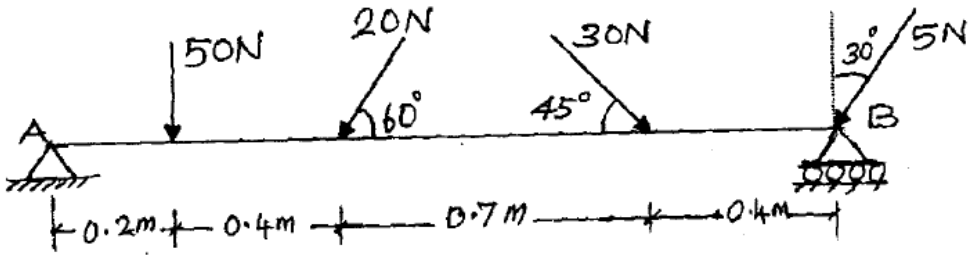
20. A particle dropped from a height of 30m hits the ground in 4 seconds, Calculate the velocity when it hits the ground.

PART – B (5 x 12 = 60 Marks)

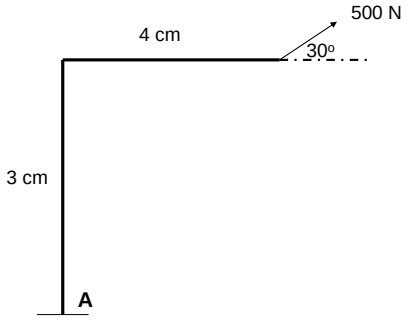
Answer **ANY FIVE** Questions

21. A force **F** acts at the origin of a coordinate system in a direction defined by the angles θx = 69.3° and θz = 57.9°. If the component of the force **F** along y direction is = -174N, determine (i) the angle θy (ii) the magnitude of the force (iii) the components of the force **F** along x and z directions and (iv) the component of the force **F** on a line through the origin.

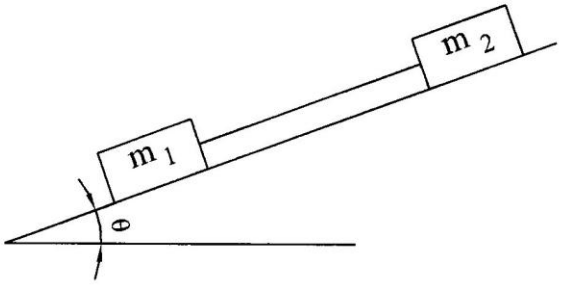
22. Calculate the pin reaction supports at A & B for the given beam.



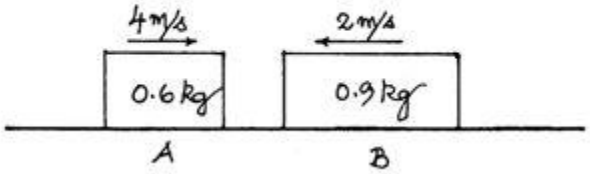
23. A frame is hinged at A and is subjected to force of 500 N as shown in the fig.below. Compute the reactions at the support points when (a) $\phi = 0^o$ (b) $\phi = 90^o$ (c) $\phi = 30^o$



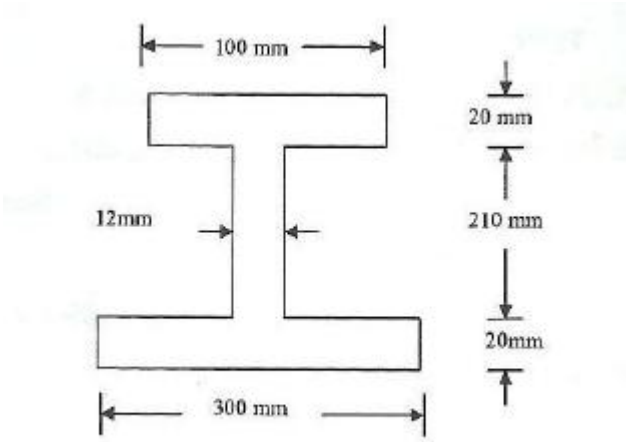
24. Two masses m_1 and m_2 are tied together by a rope parallel to the inclined plane surface, as shown in figure below. Their masses are 22.5 kg. and 14 kg. respectively. The coefficient of friction between m_1 and the plane is 0.25, while that of mass m_2 and the plane is 0.5. Determine (i) the value of the inclination of the plane surface, θ, for which the masses will just start sliding and (ii) the tension in the rope.



25. Two steel blocks, shown in figure slide without friction on a horizontal surface. The velocities of the blocks immediately before impact are as shown. If the coefficient of restitution between the blocks is 0.75, determine the velocities of the blocks after impact and the energy loss during impact.

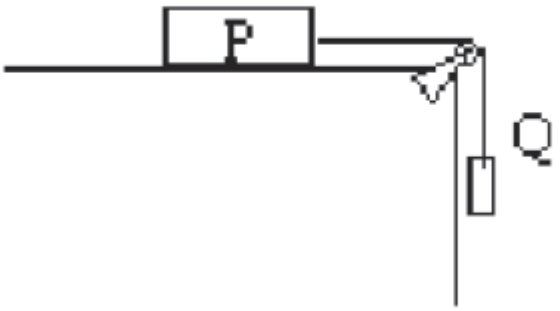


26. Determine the Moment of Inertia about both the centroidal axes for the figure given below. Also compute the radius of gyration.



27. (a) A pelton wheel is rotating at 40 rad/sec when the power is turned off. If it takes 25 seconds for the wheel to come to rest, determine the constant deceleration and total number of revolutions the wheel makes.
(b) Derive an expression for the instantaneous centre of rotation for a 2D object.

28. (a) Compute the acceleration of the moving loads as shown in the figure below. Take mass of P and Q as 120 kg and 60 kg respectively. The coefficient of friction between the surfaces of contact is 0.3. Also determine the tension in the string.



(b) Reduce the given system of forces into a force – couple system at A