AR13 **Set-02**

Code No: 13ME1002

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, TEKKALI
(AUTONOMOUS)
II B.Tech I Semester Supplementary Examinations, March 2015
CLASSICAL MECHANICS
(Mechanical Engineering for Transitory Regulation)

Time: 3 Hours **Max Marks: 70**

PART – A

Answer all questions **[10X1=10M]**

1. a) State the first law of Newton's laws of motion and hence define force.
   b) Draw neat sketches of torsional pendulum and explain.
   c) What do you understand by free body diagram? Give one example.
   d) State the law of conservation of energy.
   e) The angular displacement of a rigid body of moment of inertia 10 kg – m^2 at time t is given by $\theta = 10t^2 i-(9-2t)\, j+8k$. Find the momentum of this body at time t = 5 sec.
   f) A body was thrown vertically down from a tower and travels a distance of 50 m in the 5th second of its flight. Find the initial velocity of the body.
   g) Find the amplitude and the time period of a particle moving with SHM which has a velocity of 9 m/sec and 4 m/sec at distances of 2 m and 3 m from centre.
   h) Define the term Radius of gyration
   i) Conditions of Equilibrium
   j) Transfer formula for Mass Moment of Inertia

PART – B

Answer one question from each unit **[5X12=60M]**

2. a) Discuss in detail about different types of force systems with an example.
   b) Two blocks having weights *W*1 and *W*2 are connected by a string and rest on horizontal planes as shown in Fig.1. If the angle of friction for each block is ϕ, find the magnitude and direction of the least force *P* applied to the upper block that will induce sliding.

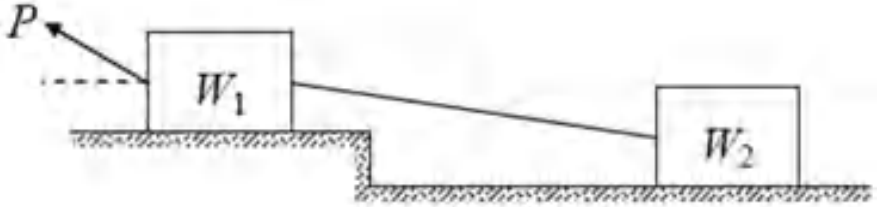

Fig.1

(OR)

3. a) Write about Triangle law and Parallelogram law of forces with an example
   b) Find the magnitude and direction of the Resultant "R" of four concurrent forces acting as shown in the Fig.2.

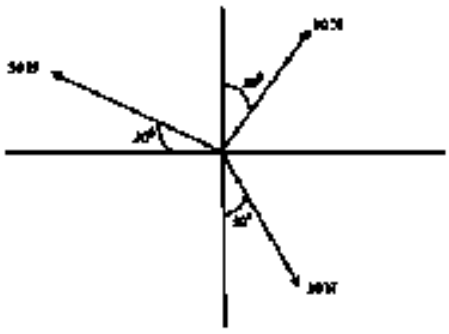

Fig.2. Concurrent force system

Unit -II

4. A cantilever truss shown in Fig. 3 is carrying a point load of 50 KN at J. Find the forces in all the members of the truss. All the inclined members are at 45 with the horizontal.

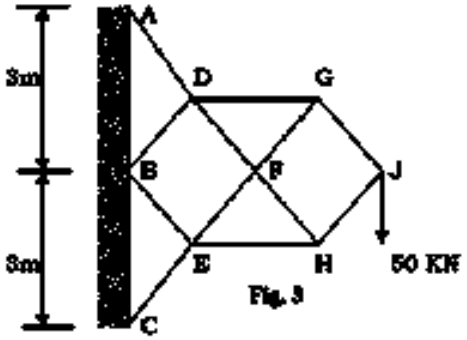

Fig. 3

(OR)

5. a) A constant force '*F*', having a magnitude of 50 kgf is applied at the end of an inextensible string as shown in Fig.4. Determine the maximum and minimum weights of blocks '*w*' for maintaining equilibrium, friction between the block and the inclined plane $\mu = 0.2$.

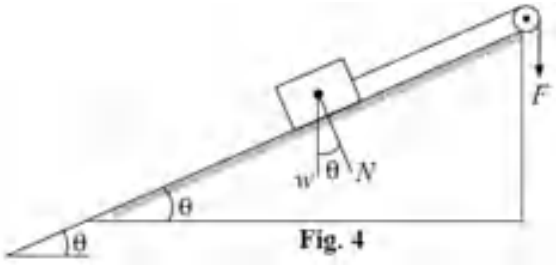

Fig. 4

b) Describe Stability of the system with an example and neat sketches.

Unit -III

6. a) Define Moment of Inertia and Center of Gravity and also Determine the Moment of Inertia of a Cylinder about its base.
   b) Determine by applying the Pappus theorem (i) the surface area and (ii) volume of a hemisphere of radius '*a*' as shown in Fig. 5 (a) and (b).

(OR)

7. a) Discuss with an example about Radius of gyration, Parallel axis and perpendicular axis theorem.
   b) Using the analytical method, determine the center of gravity of the plane uniform lamina shown in Fig.6

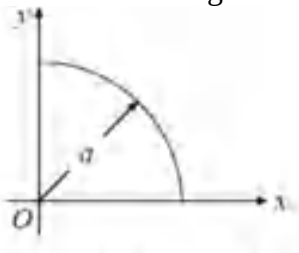

Fig. 5(a) Surface area of hemisphere

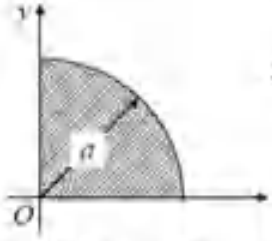

Fig. 5(b) Surface volume of hemisphere

Fig. 6 Composite Section

Unit –IV

8. a) Derive the expressions for tangential and normal acceleration of a particle having curvilinear translation.

b) A stone is dropped into a well and falls vertically with constant acceleration g = 9.81 m/sec. The sound of impact of the stone on the bottom of the well is heard 6.5 sec. after it is dropped. If the velocity of sound is 342 m/sec, how deep is the well?

c) A particle starts from rest and moves along a straight line with constant acceleration. If it acquires a velocity of 12 m/sec. after having travelled a distance of 30 m, find the magnitude of the acceleration.

(OR)

9. a) A body rotates such that the angle of rotation is given as function of time by the equation $\theta = \theta_0 + bt + ct^2$

Obtain general expressions for the angular velocity and the angular acceleration of the body. If the initial angular velocity be 2π radiations per second and after one second the angular velocity is 4π radians per second. Determine the constants b and c.

b) A particle moving with SHM performs 10 complete oscillations per minute and its speed when a distance of 150 mm from the center of oscillation is 3/5 of the maximum speed. Find the amplitude, the maximum acceleration and the speed of the particle when it is 100 mm from the centre of oscillation.

Unit -V

10. a) Explain D' Alembert's principle in rectilinear and curvilinear motion with examples.

b) A simple pendulum of weight 'w' and length '*l*' as shown in Fig.7 is released from rest at A($\alpha = 60^o$), swings downward under the influence of gravity and strikes a spring of stiffness K at 'B'. Neglecting the mass of the spring, determine the compression that it will suffer.

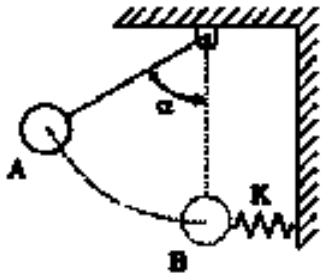

Fig.7

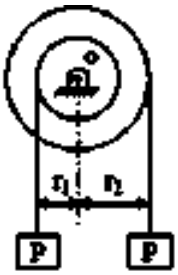

Fig.8 Pulley system

(OR)

11. a) In what proportion will the maximum range of a projectile be increased if the initial velocity is increased by 10 per cent?

b) The two step pulley in Fig.8 has weight W = 2 KN and radius of gyration K_0 = 18 cm. Develop a formula for the downward acceleration of the falling weight 'P' on the right if P = 250 N, r_1 = 25 cm and r_2 = 40 cm.