D.K.M.COLLEGE FOR WOMEN (AUTONOMOUS), VELLORE-1.

MECHANICS

UNIT I Section-A (6 Marks)

1. Define Mechanics, Dynamics and Mechanical system
2. Explain the types of forces.
3. Define Degrees of Freedom with example.
4. Prove that the degrees of freedom of any system is unique.
5. Define Co-ordinate transformation, Generalised co-ordinates and independent Generalised co-ordinates.
6. Define configuration space and classification of constraints.
7. Explain sceleronomic system with example.
8. Explain Rheonomic system with example.
9. Define Non-holonomic constraints and explain the characteristics of non-holonomic constraints.
10. Write the difference between holonomic and non-holonomic constraints.
11. Write a notes on Bilateral constraint and unilateral constraints.
12. Define virtual displacement and its vector and virtual velocity.
13. Explain virtual work of Applied Forces.
14. Explain D'Alembert's principle.
15. Explain Lagrangiom Form of D'Alembert's principle.
16. State and prove principle of work and kinetic energy.
17. Explain the total kinetic energy of a rigid body.
18. Explain Angular momentum of system of particles w.r.to fixed point and in terms of centre of mass.

UNIT II

1. Explain the characteristic of the terms T_2,T_1,T_0.
2. Derive the standard form of Lagrange's Equation for Holonomic system.
3. Derive the standard form of Lagrange's Equation for non-holonomic system.
4. Find the differential equation of motion for a spherical pendulum of length l.
5. Two Particles are connected by a rigid massless rod of length l which rotates in a horizontal plane with a constant angular velocity w knife-edge supports at the two particles prevent either particle from having a velocity component at the rod. Find the different equation of motion at the origin and has a velocity v_0 in the positive y direction.
6. Discuss Kepler problem using Routhian function.
7. Explain Natural system with Example.
8. Explain the term ignorable Coordinates.
9. Derive Equations of motion.

UNIT III

1. Explain the Stationary values of a Function.
2. Find the necessary condition for a stationary value of the definite integral $I=\int_{x0}^{x1} F(y(x),y'(x),x)dx$ where $y'(x)=dy/dx$ and the limits x_0 and x_1 are fixed.
3. Explain the brachistochrone problem.
4. Explain geodesic problem that is the problem of finding the shortest path between the two points in a given space.
5. Find the stationary values of the function F=z, subject to the constraints $\Phi_1=x^2+y^2+z^2-4=0$, $\Phi_2=xy-1=0$.
6. Solve Kepler's problem using polar co-ordinates.
7. Derive modified Hamilton's principle.
8. Derive Jacobi's form of principle of least action.
9. Obtain the orbit for the Kepler problem using the Jacobi form of the principle of least action.

UNIT IV

1. State and prove Jacobi's theorem.
2. Define 1)orthogonal systems, 2)seperability, 3)Lioville's system .
3. Derive modified Hamilton-Jacobi equation.
4. Define Pfaffian differential form and explain it.
5. Explain conservative systems and Ignorable co-ordinates.
6. Using Hamilton – Jacobi method analyze the kepler problem.
7. Solve Kepler problem using Jacobian equation.

UNIT V

1. Show that the transformation $Q=\sqrt{2qe^t}\cos p$, $P=\sqrt{2qe^{-t}}\sin p$ is constant.
2. State and prove Poisson's theorem.
3. Show that the transformation $Q=1/2(q^2+p^2)$ and $p=-\tan^{-1}(q/p)$ is canonical.
4. Explain canonical transformations for holonomic systems.
5. Explain point transformations & Moment transformations.
6. Derive the expression of Lagrangian bracket.
7. Consider the transformation $Q=\sqrt{e^{-2q}}-p^2$, $p=\cos^{-1}(pe^q)$ using poisson bracket, show that it is Canonical.

UNIT I Section B (15 marks)

1. State and prove principles of virtual work.
2. Explain the application of the virtual work.
3. Obtain the virtual work of the applied forces in terms of generalized coordinates.
4. State and prove principle of conservation of energy.
5. State and prove koniy's theorem.
6. Obtain the expression for the rotational K.E(T_{rot})

7. Obtain the angular momentum of system of N particles w.r to an orbitrary reference
point P.
8. A particle of mass 'm' is suspended by amass less wire of length r=a+b coswt (a>b>0) to form a Spherical Pendulum. Find the equation of motion.

Unit II

1. Derive Lagrange's equations for holonomic & non holonomic System.
2. Derive the expression for total kinetic energy of system of particle.
3. Derive the lagrange's equation.
4. Obtain the forms of equation of motion.
5. A double pendulum consists of two particles suspended by massless rods. Assuming that all motion takes place in a vertical plane. Find the differential equations of motion.
6. Derive the expression of Routhian function.

Unit III

1. State and prove principle of least action.
2. Find a curve y(x) between the origin 'o' and the point (x,y) such that a particle starting from a rest at 'o' and sliding curve without friction under gravity will reach the end of curve in a minimum time.
3. Obtain the stationary value of a Definite Integral.
4. State and prove Hamilton's principle.
5. Explain Hamilton's principle for non-holonomic system.
6. Obtain the Derivation of Hamilton's Equation.
7. Explain the Legendre Transformation.

Unit IV

1. State and prove Stackel's theorem.
2. Derive Hamilton's Canonical Integral.
3. Explain Hamilton-Jacobi method through simple mass spring system.

Unit V

1. Explain the bilinear Covirat and prove that it is invariant with respect to a canonical.a
2. For the transformation $Q=q-tp+1/2gt^2$, P=p-gt. Find K-H and the generating function.
3. Explain principle forms of Generating functions.
4. Explain Homogeneous Canonical Transformations.
5. State and prove Poisson's theorem.