



Shree H.N. Shukla College of Science
M. Sc (Mathematics) (Sem-1)
Preliminary Exam
MATH.CMT-1001
Classical Mechanics - 1

[Time: 2:30 Hours]

[Total Marks: 70]

- Instructions:** (1) All questions are compulsory.
(2) There are 5 questions.
(3) Figures on right side indicate full marks.

1. Attempt any seven : **14**

- 1) Define: Torque or moment of force.
- 2) Define : Configuration Space
- 3) Define : Monogenic system
- 4) Define : Linear Momentum
- 5) Define : Cyclic Co-ordinates
- 6) When a system said to be conservative?
- 7) Define with example : Holonomic Constraints
- 8) Define with example : Non Holonomic Constraints
- 9) Define with example : Rheonomous Constraints
- 10) State only the Hamilton's variational principle

2. Answer the following : **14**

- 1) State and prove Angular momentum conservation theorem for a system of particles
OR
Discuss in detail the conservation of total energy for a system of particles.
- 2) Derive the Lagrange's equation of motion for general system.

3. Attempt the following: **14**

- 1) Derive the Lagrange's equation of motion for a single particle in space with mass m in Cartesian co-ordinates and Plane polar co-ordinates.
OR

Discuss in detail the problem of Atwood machine.

- 2) Find the shortest distance between two points in plane.

4. Attempt the following:

14

- 1) A particle falls a distance y_0 in a time $t_0 = \sqrt{\frac{2y_0}{g}}$. If the distance $y = at + bt^2$ then show that the integral $\int_t^{t_0} Ldt$ has an extremum for real values of coefficients only when $a = 0$ and $b = \frac{g}{2}$
- 2) A hoop rolling without slipping down an inclined plane then find the force of friction acting on the hoop.

5. Attempt any two :

14

- 1) Derive the equations of motion and find the first integrals for two bodies central force problem.
- 2) Discuss in detail the use of direction cosine to describe the independent co-ordinates relative to the rigid body motion.
- 3) Define the orthogonal transformation in terms of Cayley-Klein parameters.

All the Best