Master of Science Examination, 2017

(1st Year, 1st Semester) **(EVENING)**

Classical Mechanics I

Paper – PHY / TG / 101

Time – Two hours

Full Marks : 40

Answer any **four** questions

1. a) The Lagrangian of a system is given by

$$L = \frac{m^2\dot{x}^4}{12} + m\dot{x}^2V(x) - V^2(x)$$

Identify the system.

b) What is the principle of 'Mechanical Similarity'? Use it to justify the Kepler's third law.

c) Prove Virial Theorem.

3+4+3

2. a) Show that Poisson Bracket is invariant under canonical transformation.

b) Show that if A and B are two constants of motion then [A,B] is also a constant of motion.

c) Find the constant of motion of a two dimensional simple harmonic oscillator.

3+3+4

3. a) The Lagrangian of a system is given by

$$L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2) - \frac{1}{2}(\mu x^2 + \mu y^2 + 2kxy)$$

Find the eigen-frequencies and ratio of the amplitudes.

b) Show that $(A')^T\, T\, (A') = I$ where the symbols have their usual meaning.

c) Find the normal co-ordinates in case of (3a).

4+3+3

4. a) Find the moment of inertia tensor of a square plate taking axes at one corner of the plate.

b) Hence find the principal moments of inertia and directions of principal axes.

c) Show that $L_i = \frac{\partial T}{\partial W_i}$ where the symbols have their usual meaning.

4+3+3

5. a) Discuss the motion of a heavy symmetrical top.

b) Find the generating function for which the transformed Hamiltonian of an one dimensional simple harmonic oscillator after canonical transformation will be proportional to square of the generalised momentum only.

6+4