Bago University
Department of Physics
First Semester Examination, March 2019

Third Year (BSc)
(Physics Specialization)

Phys 3105
Classical Mechanics
Time Allowed: (3) Hours

Answer any Six questions.

1 (a) Derive the analogue of Newton's second law in rotational motion.

(b) A particle of mass 'm' moves along the x- axis under a constant force f starting from rest at the origin at time $t = 0$. If T and V are kinetic and potential energies of the particle, calculate $\int_0^{t_0}(T-V)dt$.

2 (a) Prove that the energy conservation theorem for a particle moving in the conservative force field.

(b) A particle having total energy E is moving in a potential field V(r). Show that the time taken by the particle to move from r_1 to r_2 is $t_2 - t_1 = \int_{t_1}^{t_2} \frac{dr}{\sqrt{2(E-V)/m}}$.

3 (a) Define the following terms: (i) conservative force (ii) inertial reference frames (iii) Non inertial reference frame.

(b) Describe the conservation of angular momentum of a system of particles. Ball A of mass m is attached to one end of a rigid massless rod of length $2l$, while an identical ball B is attached to the centre of the rod. This arrangement is held by the empty end and is whirled around in a horizontal circle at a constant rate. Ball A travels at a constant speed of v_A. Find the tension in each half of the rod.

4 (a) Show that the time rate of angular momentum is equal to the total external torque.

(b) A body of mass 'm' splits into two masses 'm_1' and 'm_2' by an explosion. After the split the bodies move with a total kinetic energy 'T' in the same direction. Show that their relative speed is $\sqrt{2Tm/m_1m_2}$.

5 (a) Consider the interaction of radio waves with electrons in the ionosphere. Find the velocity and position of the electron as a function of time.

(b) Particles of masses 4, 3, 1kg move under a force such that their position vectors at time 't' are $\vec{r}_1 = 3\hat{j} + 2t^2\hat{k}$, $\vec{r}_2 = 3t\hat{i} - \hat{k}$ and $\vec{r}_3 = 4t\hat{i} + t^2\hat{j}$. Find the position of the center of mass and the angular momentum of the system about the origin at $t = 2s$.

6 (a) State the D' Alembert's principle.

(b) Consider the motion of a particle of mass 'm' moving in space. Selecting the cylindrical co-ordinates (ρ, ϕ, z) as the generalized co-ordinates, calculate the generalized force components if a force 'F' acts on it.

7 (a) Write down the mathematical form of Hamilton's Principle, generalized version of Hamilton's Principle and Euler-Lagrange differential equation.

(b) Show that the shortest distance between two points is a straight line.

8 (a) Derive the Euler Lagrange differential equation from Hamilton's principle.

(b) Using Lagrange's method of undetermined multiplier, find the equation of motion and force of constraint in the case of a simple pendulum.
