Indian Institute of Science Education and Research, Mohali

Classical Mechanics (PHY301)

(August – December 2022)

Mid-Semester Exam I)

September 19, 2022

Name:

Roll Number:

Duration of this exam is 60 minutes.

Please write your name and roll number on the question paper as well as the answer sheet.

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1. Consider a harmonic oscillator in two dimensions:

$$U = \frac{1}{2}kr^2 \quad , \quad r^2 = x^2 + y^2$$

For this system:

(a) Write down the kinetic energy and potential energy for this system and obtain an expression for the Lagrangian. [1]

(b) Derive the equation of motion. [2]

(c) List cyclic coordinates for the system and give an explanation as to why these are cyclic coordinates? [2]

(d) What are the conserved quantities (integrals of motion) for this system? [2]

(e) Draw phase space diagrams for this system. Please make an attempt to plot all qualitative types that can occur for this system. [4]

(f) Derive the Hamiltonian for this system. [2]

(g) Derive the Hamiltonian equations of motion for this system. [2]