Seat No: _____ **Enrollment No: _____**

PARUL UNIVERSITY

FACULTY OF APPLIED SCIENCE

M.Sc./IMSC, Winter 2019-20 Examination

Semester: 1/7 **Date: 02/12/2019**
Subject Code: 11204102 **Time: 10:30 am to 01:00 pm**
Subject Name: Classical Mechanics I & Statistical Mechanics **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1. A) Essay type/ Brief note (4x2) (Each of 04 marks) **(08)**
(a) Derive the Canonical transformation equation using the generating function F(q,Q,t) and F(q,P,t).
(b) Derive the canonical equation in term of Poisson bracket.

Q.1. B) Answer the following questions (Any two)
(a) Short note/ Brief note (2x2)/ Schematically label the figures (2x2) (Each of 02 marks) **(04)**
1. Define Poisson bracket
2. Define eigen vector and eigen frequency.

(b) Explain the separation of variable in the Hamilton Jacobi equation. **(04)**
(c) Briefly explain the small oscillation of the particle on string. **(04)**

Q.2. A) Answer the following questions.
(a) Short note/ Brief note (2x2)/ Fill in the blanks. (Each of 02 marks) **(04)**
1. Write down the Hamiltonian equation of motion
2. Write down the general case of coupled oscillation

(b). Explain the application of Euler's angle in the heavy symmetric top. **(04)**

Q.2. B) Answer the following questions (Any two)
(a) Short note/ Multiple choice questions. (Each of 01 marks) **(03)**
1. Lagrangian L is:
(A) $L = \sum p\dot{q} - H$ (B) $L = \sum p\dot{q} + H$
(C) $L = \sum pq - H$ (D) $L = \sum p\dot{q}$
2. For a transformation to be canonical, if:
(A) Poisson bracket changes sign (B) Poisson bracket becomes zero
(C) Poisson bracket becomes unity (D) Poisson bracket becomes invariant
3. The normal coordinate x_K is
(A) $Ce^{i\omega t}$ (B) $Ce^{i\omega t}$ (C) $Ce^{i\omega t}$ (D) $Ce^{i\omega t}$

(b) Derive the expression of Hamilton Jacobi equation. **(03)**
(c) Define and explain the Euler's angle. **(03)**

Q.3. A) Essay type/ Brief note (4x2) (Each of 04 marks) **(08)**
(a) Explain the power spectrum of fluctuation and their correlation.
(b) Explain the first order phase transition

Q.3. B) Answer the following questions (Any two)
(a) Short note/ Brief note (2x2)/ Schematically label the figures (2x2) (Each of 02 marks) **(04)**
1. Write down the statement of fluctuation-dissipation theorem.
2. Draw a Phase transition diagram for water.

(b) Explain the Brownian motion of particles. **(04)**
(c) Describe the Vander Walls theory of liquid condensation. **(04)**

Q.4. A) Answer the following questions.
(a) Short note/ Brief note (2x2)/ Fill in the blanks. (Each of 02 marks) **(04)**
1. Fokker Planck equation is ……..
2. Clusius - Clayperon equation is…….

(b) Describe the theory of Ising model. **(04)**

Q.4. B) Answer the following questions (Any two)

(a) Short note/ Multiple choice questions. (Each of 01 marks) **(03)**

1. The Gibbs free energy is:

(A) G= H+TS (B) G= H-TS (C) G= TS (D) None of these

2. Latent heat is:

(A) T-ΔS (B) T+ΔS (C) T/ΔS (D) TΔS

3. Shot noise is related to:

(A) Sound vibration (B) During the generation of waves

(C) fluctuation due to discrete charge carriers (D) None of these

(b) State and explain Wiener - Khinching theorem. **(03)**

(c) Write down the condition of Phase equilibrium. **(03)**