17PPH01

(For the candidates admitted from 2017–2018 onwards)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017.

First Semester

Physics

CLASSICAL AND STATISTICAL MECHANICS

Time : Three hours   Maximum : 75 marks

SECTION A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The force of constraint obeys

    (a) Newton's gravitational law third law of motion

    (b) Einstein's relativity

    (c) Newton's third law of motion

    (d) friction

2. A simple pendulum is taken inside a deep mine. Relative to the period of oscillation on the surface, the time period inside the mine

    (a) remains the same

    (b) increases

    (c) decreases

    (d) becomes

3. Which of the following particles experiences a Corioli's force?

    (a) A particle at rest with respect to earth at Bhopal

    (b) A particle thrown vertically upwards at Bhopal

    (c) A particle thrown vertically upwards at the north pole

    (d) A particle moving horizontally along the north—south direction at the equator.

4. The transformation $Q = aq + bq, P = cp + ap$ is a canonical transformation if

    (a) $ad - bc = 1$ (b) $ad - bc = 0$

    (c) $ad + bc = 1$ (d) $ad + bc = 0$

5. Euler's equation predicts that the shortest distance between two fixed points in a plane is a

   (a) circle   (b) curve

   (c) plane   (d) straight line

6. The number of independent coordinates required to describe the motion of a rigid body is

   (a) 2   (b) 6

   (c) 3   (d) 1

7. A micro-canonical ensemble represents

   (a) A system in contact with a heat reservoir

   (b) an isolated system in equilibrium

   (c) a system that can exchange particles with its surroundings

   (d) a system under constant external pressure

8. The ensemble used to obtain the equation of state for an ideal Bose gas is

   (a) Canonical ensemble

   (b) Micro-canonical ensemble

   (c) Macro-canonical ensemble

   (d) Grand-canonical ensemble

9. Bose-Einstein condensation temperature is defined as the temperature at which

   (a) the number of atoms in the excited state is equal to the total number of atoms

   (b) the number of atoms in the ground state equals the number of atoms in the excited state

   (c) the number of atoms in the excited state is 0

   (d) the ground state becomes unstable

10. One-dimensional ising model

   (a) Shows at ferromagnetism at $T = 0$

   (b) Shows at ferromagnetism for $T < Tc$

   (c) Shows at ferromagnetism for $T > Tc$

   (d) Never exhibits ferromagnetism

   SECTION B — ($5 \times 5 = 25$ marks)

   Answer ALL questions.

11. (a) Define and explain: dependent forces and the dissipation function.

   Or

   (b) Discuss in brief, simple pendulum based on Lagrange's formulation.

12. (a) Solve the problem of simple harmonic oscillator in one dimension by effecting a canonical transformation.

Or

(b) Explain the Poisson brackets and obtain equation, of motion.

13. (a) Give theory of small oscillations in Lagrangian formulation.

Or

(b) Write a note on relativistic kinematics.

14. (a) Define and explain :

(i) phase-space and

(ii) micro canonical ensembles.

Or

(b) Explain entropy in statistical mechanics.

15. (a) Explain the specific heat anomaly of metals and its solution.

Or

(b) Discuss in brief about cluster expansion for a classical gas.

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SECTION C — (5 × 8 = 40 marks)

Answer ALL questions.

16. (a) Define and explain :

(i) D'Alembert's principle

(ii) Generalized coordinates

Or

(b) Write the notes on:

(i) isotropic oscillator,

(ii) harmonic oscillator.

17. (a) Explain canonical transformation and its examples.

Or

(b) Discuss the Kepler's problem in action angle variables.

18. (a) Describe torque free motion of rigid body.

Or

(b) Define and discuss the Eulerian angles and Eulerian theorem.

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19. (a) Describe ideal gas in canonical and grand canonical ensembles.

Or

(b) Discuss the connection between the statistical and thermodynamic quantities.

20. (a) Discuss the Maxwell-Boltzmann statistics.

Or

(b) Describe Ising model in one and two dimensions.

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