9. (a) Establish the thermodynamic equivalence of the microcanonical, the canonical and the grand canonical ensembles.

Or

(b) Obtain the entropy of the ideal gas on the basis of grand canonical ensemble and hence derive the other thermodynamic relations.

10. (a) Derive an expression for Fermi-Dirac distribution law. How it differs from MB and BE distribution laws?

Or

(b) What is meant by Bose-Einstein gas? Also explain Bose-Einstein condensation.

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S.No. 177

12PPH01

(For the candidates admitted from 2012-2013 onwards)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2017.

First Semester

Physics

CLASSICAL AND STATISTICAL MECHANICS

Time : Three hours Maximum : 75 marks

PART A — (5 × 5 = 25 marks)

Answer ALL questions.

1. (a) What is meant by constraint motion? Distinguish between holonomic and non-holonomic constraints with suitable example.

Or

(b) State and explain the Hamilton's principle and derive Lagrange's equation of motion for a conservative system from this principle.

2. (a) Show that the transformation :

$$Q = \sqrt{2q}\, e^{\alpha} \cos p$$
$$P = \sqrt{2q}\, e^{-\alpha} \sin p$$

is a canonical transformation

Or

(b) What are action – angle variables? Explain how they can be used to obtain the frequencies of periodic motion.

3. (a) Enunciate the principles of special theory of relativity and derive Lorentz transformation equations.

Or

(b) Discuss the theory of a spinning symmetrical top under gravity.

4. (a) Explain the thermodynamic potentials and their dependence on the number of particles in the system.

Or

(b) What is Gibbs paradox? How is it resolved?

5. (a) Obtain the equation of state of a Fermi gas at finite time.

Or

(b) Derive an expression for energy radiation density of a black body and hence explain the energy spectrum.

PART B — (5 × 10 = 50 marks)

Answer ALL questions.

6. (a) Find the Lagrange's equation of motion of an electrical circuit containing an inductance L and capacitance C. The capacitor is charged to Q coulombs and current flowing in the circuit is I amperes.

Or

(b) State and prove the principle of least action.

7. (a) Give an account of Hamilton – Jacobi theory and illustrate it by applying to the problem of simple harmonic oscillator.

Or

(b) Explain the infinitesimal contact transformation. Discuss the relation between infinitesimal contact transformation and poisson's bracket.

8. (a) What are small oscillations? Describe the small oscillations of the CO_2 molecule and obtain the vibrational frequencies of their modes.

Or

(b) Obtain an expression for the relativistic kinetic energy and hence find the mass energy relation.