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B. Sc. (Sem.-V) Examination October - 2025

Physics - Classical and Statistical Mechanics (MJ-PH(TH) - 502)

Time: 2 Hours] **[Total Marks: 25**

સૂચના : / Instructions

(1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book

(2) Draw neat diagrams wherever necessary.

(3) Symbols used in the paper have their usual meaning.

(4) Figures to the right indicate full marks of the question.

(5) Scientific calculator may be used.

Seat No.:

Student's Signature

Q.1. Answer the following questions in brief: (Attempt any five) **5**

1. Define degree of freedom of the system.
2. What is the direction of angular momentum vector in an orbital motion?
3. If a generalized co-ordinate of dimension of momentum, then what is the unit of Generalized velocities ?
4. Define the thermodynamic probability?
5. How many ways, 'n' distinguishable particles can be distributed in two identical compartments.
6. What do you mean by canonical ensemble?

Q.2. (a) Attempt any one of the following in details: **7**

1. Derive Langrange's equation of motion from D'alembert's principle.
2. What is central force ? Using central force motion to obtain the equation of orbit in the form

$$\theta(r) - \theta_0 = \int_{r_0}^{r} \frac{\left(\frac{L}{r^2}\right)dr}{\left[2\mu\left(E - V - \frac{L^2}{2\mu r^2}\right)\right]^{\frac{1}{2}}}$$

(b) Attempt any one of the following **3**

1. Is the Langrangian formulation more advantageous than the Newtonian formulation? Why ?
2. The periodic time of Venus is 224.7 days and that of earth 365.26 days. Then find the ratio of the major axis of orbit of Venus and the earth.

Q.3. (a) Attempt any one of the following in details: **7**

1. Explain the concept of phase space and prove that the number of quantum states included in any interval of any of the co-ordinate is directly proportional to the length of the interval.
2. Derive the Maxwell-Boltzmann distribution law.

(b) Attempt any one of the following **3**

1. Calculate the number of available quantum states to a proton inside the nucleus (radius = 10^{-14} m) whose momentum cannot exceed 10^{-19} kg ms^{-1}.
2. The system consisting of two particles which can exist in three different energy states. Calculate the number of ways in which these particles can be distributed in a given state for Fermi-Dirac statistics.

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