**2017**

( 5th Semester )

PHYSICS

SEVENTH PAPER

**( Classical Mechanics and Thermal Physics )**

( Pre-revised )

*Full Marks* : 55

*Time* : 2½ hours

( PART : B—DESCRIPTIVE )

( *Marks* : 35 )

*The figures in the margin indicate full marks for the questions*

**1.** *(a)* Show that a two-body problem can be reduced to a one-body problem. 3

*(b)* Deduce Kepler's law of planetary motion from Newton's law. 4





*Or*

*(c)* Explain the principle of virtual work. 3

*(d)* Using Hamiltonian formulation, obtain the equation of motion for a simple pendulum. 4

**2.** Describe how Perrin verified Einstein theory of Brownian motion experimentally and led him to determine Avogadro's number. 7

*Or*

Deduce the Maxwell-Boltzmann law for the distribution of velocities. 7

**3.** *(a)* Derive an expression for the coefficient of thermal conductivity. 4

*(b)* Define Helmholtz function $F$. Show that the change in Helmholtz function during an infinitesimal reversible process is $dF \quad PdV \quad SdT$. 1+2=3

*Or*

*(c)* What is triple point? 1

*(d)* Deduce the four Maxwell's thermodynamical relations from thermodynamical energy function. 6

**4.** *(a)* Define accessible states. 1

*(b)* Calculate the number of phase cells in energy range of 0 to $E$, for a linear simple harmonic oscillator and a free particle of mass $m$ and frequency . 6

*Or*

*(c)* State the theorem of equipartition of energy. 1

*(d)* Derive Boltzmann's canonical distribution law. 6

**5.** *(a)* Discuss indistinguishability of a particle in Bose-Einstein and Fermi-Dirac statistics. 2

*(b)* Using Maxwell-Boltzmann distribution law, show that the internal energy of an ideal monatomic gas depends only on its temperature. Hence show that $C_v \quad \frac{3}{2}R$. 4+1=5

*Or*

*(c)* Write any two point of differences between Bose-Einstein and Fermi-Dirac statistics. 2

*(d)* Starting from Fermi-Dirac distribution law, derive the expression for energy distribution of free electrons in a metal. 5

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**Subject Code : PHY/V/07 (PR)**

**Booklet No. A**

Date Stamp .....

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**To be filled in by the Candidate**

DEGREE 5th Semester
(Arts / Science / Commerce / ..... ) Exam., **2017**

Subject .....

Paper .....

**INSTRUCTIONS TO CANDIDATES**

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

**To be filled in by the Candidate**

DEGREE 5th Semester
(Arts / Science / Commerce / ..... ) Exam., **2017**

Roll No. .....

Regn. No. .....

Subject .....

Paper .....

Descriptive Type

Booklet No. B .....

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*Signature of Examiner(s)*

*Signature of Invigilator(s)*

**/211**

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( 5th Semester )

**PHYSICS**

SEVENTH PAPER

**( Classical Mechanics and Thermal Physics )**

( Pre-revised )

( PART : A—OBJECTIVE )

( *Marks* : 20 )

*The figures in the margin indicate full marks for the questions*

SECTION—I

( *Marks* : 5 )

Tick (✓) the correct answer in the brackets provided : 1×5=5

**1.** Lagrange's equation for generalized coordinate is given by

*(a)* $\frac{\partial}{\partial t}\left(\frac{\partial L}{\partial q}\right) - \frac{\partial L}{\partial \dot{q}} = 0$ ( )

*(b)* $\frac{\partial}{\partial t}\left(\frac{\partial L}{\partial q}\right) + \frac{\partial L}{\partial \dot{q}} = 0$ ( )

*(c)* $\frac{\partial}{\partial t}\left(\frac{\partial L}{\partial \dot{q}}\right) - \frac{\partial L}{\partial q} = 0$ ( )

*(d)* $\frac{\partial}{\partial t}\left(\frac{\partial L}{\partial \dot{q}}\right) + \frac{\partial L}{\partial q} = 0$ ( )

**2.** The most probable velocity of a gas molecule is

*(a)* $\sqrt{\frac{m}{3kT}}$ ( )

*(b)* $\sqrt{\frac{3kT}{m}}$ ( )

*(c)* $\sqrt{\frac{m}{2kT}}$ ( )

*(d)* $\sqrt{\frac{2kT}{m}}$ ( )

**3.** Viscosity of a gas is due to the transport of

*(a)* energy ( )

*(b)* mass ( )

*(c)* momentum ( )

*(d)* velocity ( )

**4.** The thermodynamic probability of a system in equilibrium is

*(a)* maximum ( )

*(b)* minimum but not 1 ( )

*(c)* 1 ( )

*(d)* 0 ( )

**5.** Deduction of Planck's law is possible on the basis of

*(a)* Fermi-Dirac statistics ( )

*(b)* Classical statistics ( )

*(c)* Maxwell-Boltzmann statistics ( )

*(d)* Bose-Einstein statistics ( )

## SECTION—II

( *Marks* : 15 )

Answer the following questions : 3×5=15

**1.** Obtain the gravitational potential for a thin spherical shell.

**2.** Obtain the equation for the mean or average speed of a gas molecule.

**3.** Show that for a perfect gas $C_p - C_v = R$.

**4.** What are canonical, micro-canonical and grand-canonical ensembles?

**5.** How does Fermi energy vary with temperature?

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