I/PHY (i) (PR)

2016

(1st Semester)

PHYSICS

FIRST PAPER

(Mechanics and Thermodynamics)

(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)* A reference frame S' rotates with respect to another frame S with a uniform angular velocity $\vec{\omega}$. If $\vec{r}$, $\vec{V}$ and $\vec{F}$ represent the position, velocity and force on a particle of mass m in the frame S, and if $\vec{F}'$ represents the force on the particle in the frame S' at any instant t, then show that

$$\vec{F} = \vec{F}' - 2m\vec{\omega} \times \vec{V}' - m\vec{\omega} \times (\vec{\omega} \times \vec{r})$$

where $\vec{V}'$ is the velocity of the particle in frame S'. 5

(b) What are conservative and non-conservative forces? 2

Or

(a) What is centre of mass? Show that in the absence of any external force, the velocity of the centre of mass remains constant. 1+3=4

(b) State and prove work-energy theorem. 3

2. *(a)* Derive the expression for the moment of inertia of a solid cylinder about an axis passing through its centre and perpendicular to its own axis of cylindrical symmetry. 5

(b) What are elastic and inelastic collisions? Give one example in each case. 1+1=2

Or

(a) Establish Einstein's mass-energy relation. 5

(b) What are inertial and non-inertial frames of reference? 1+1=2

3. *(a)* Derive an expression for the depression of the loaded end of a cantilever when the weight of the beam is ineffective. 5

(b) Define Poisson's ratio. Show that its value lies between -1 and $0 \cdot 5$. 1+1=2

Or

(a) Derive the equation of continuity of fluid flow. 4

(b) Explain the significance of Reynolds' number. 3

4. (a) Derive the expression for the pressure exerted by an ideal gas. 5

(b) Discuss the kinetic interpretation of temperature. 2

Or

Set up the differential equation for rectilinear flow of heat in a rod heated at one end and solve it for a rod of—

(a) infinite length;

(b) finite length. 7

5. (a) Using Maxwell's thermodynamical relations, obtain Clausius-Clapeyron latent heat equation. 4

(b) What are reversible and irreversible processes? Explain with examples. 3

Or

(a) What is a heat engine? Show that in a Carnot heat engine, the mechanical work obtained is numerically equal to the area of the Carnot cycle. 1+4=5

(b) The efficiency of a reversible engine is 60% when the source temperature is 300 °C. Find the temperature of the sink. 2

★★★

Subject Code : I/ PHY (i) (PR)

Booklet No. A

Date Stamp ....

....

To be filled in by the Candidate

DEGREE 1st Semester
(Arts / Science / Commerce / ....) Exam., **2016**

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 1st Semester
(Arts / Science / Commerce / ....) Exam., **2016**

Roll No. ....

Regn. No. ....

Subject ....

Paper ....

Descriptive Type
Booklet No. B ....

Signature of Scrutiniser(s)

Signature of Examiner(s)

Signature of Invigilator(s)

/19

2 0 1 6

(1st Semester)

PHYSICS

FIRST PAPER

(Mechanics and Thermodynamics)

(Pre-revised)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The condition for the force $\vec{F}$ to be conservative is

(a) $\vec{\nabla} \times \vec{F} = 0$ ( )

(b) $\vec{\nabla} \cdot \vec{F} = 0$ ( )

(c) $\vec{\nabla} \times \vec{F} \neq 0$ ( )

(d) $\vec{\nabla} \times \vec{F} = -\vec{\nabla} \cdot \vec{F}$ ( )

2. If the moment of inertia of a spherical shell about its diameter is $\frac{2}{3}MR^2$, then its moment of inertia about a tangent is

(a) $\frac{5}{3}MR^2$ ( )

(b) $\frac{4}{5}MR^2$ ( )

(c) $\frac{7}{5}MR^2$ ( )

(d) $\frac{4}{3}MR^2$ ( )

3. The angle of contact of mercury with glass is

(a) 90° ( )

(b) less than 90° ( )

(c) 0 ( )

(d) about 140° ( )

4. Specific heat ratio for a monatomic gas is

(a) $\frac{5}{2}$ ( )

(b) $\frac{5}{3}$ ( )

(c) $\frac{3}{5}$ ( )

(d) $\frac{7}{5}$ ( )

5. The first law of thermodynamics is basically conservation of

(a) linear momentum ( )

(b) energy ( )

(c) angular momentum ( )

(d) torque ( )

SECTION—II

(*Marks* : 15)

Give very short answers to the following questions : $3 \times 5 = 15$

1. State and explain the principle of conservation of angular momentum.

2. A rod of length 1 m is moving with a velocity $0 \cdot 6c$. Calculate the length of the rod as it appears to an observer on the earth.

3. Deduce Stokes' law from dimensional analysis.

4. Calculate the temperature at which the r.m.s. velocity of oxygen molecules will be equal to that of hydrogen molecules at 0 °C, pressure being the same in both cases.

5. Explain the impossibility of attaining the absolute zero temperature.

★★★