

**First Year B.Sc., Degree Examination****Directorate of correspondence course****July / August 2011****PHYSICS****Paper I : Mechanics, Properties of Matter, Heat and Thermodynamics**

Time: 3 hrs.]

[Max.Marks: 75/85

**Instructions to candidates:-**

1. Students who have attended 25 Marks IA Scheme will have to answer for total of 75 Marks.
2. Students who have attended 15 Marks IA Scheme will have to answer for total of 85 Marks.
3. Section E is compulsory for 85 marks scheme only.

**SECTION – A****I. Answer All questions.**

10 x 1 = 10 Marks

1. Define the centre of mass frame.
2. Define areal velocity.
3. What is the maximum time period of a geo-stationary satellite to revolve around the earth?
4. Steel is more elastic than rubber. Why?
5. Define moment of inertia of body in terms of its kinetic energy.
6. State Carnot's theorem.
7. Write an expression for work done in an isothermal process.
8. Define Solar Constant.
9. Give the relation between surface Tension and surface energy.
10. What is temperature inversion?

**Contd....2**

## SECTION - B

## II. Answer any FIVE questions.

5 x 3 = 15 Marks

11. Show that, if  $\frac{d|\vec{A}|}{dt} = 0$ , then  $\vec{A}$  is perpendicular to  $\frac{d\vec{A}}{dt}$ .
12. State and prove the Kepler's third law from Newton's law of gravitation.
13. State and prove the theorem of perpendicular axes.
14. Define the mean free path of a molecule. Obtain an expression for it.
15. Draw the curves showing the distribution of energy in the spectrum of a black body at  $T_1, T_2, T_3$  such that  $T_1 > T_2 > T_3$ . Discuss the significance of the curves.
16. Compare the radiant emittance of a black body at 200K and 2000K. given  $\sigma = 5.672 \times 10^{-8}$  Mks unts.
17. Obtain the relation between 3 elastic constants.

## SECTION - C

## III. Answer any FIVE questions.

5 x 6 = 30 Marks

18. What is compound pendulum? Obtain an expression for time period of revolution of it.
19. In a two - dimensional elastic oblique collision between identical masses with target at rest, show that the particles move along mutually perpendicular directions.
20. Distinguish between critical velocity and terminal velocity. Obtain an expression for Stoke's law from dimensional analysis.
21. What are Galilian transformations? Show that the force acting on the particle is invariant under inertial frame.
22. What is T-S diagram? Explain. Derive an expression for change in entropy when ice changes into steam.
23. Distinguish between ideal and real gases. Explain the principle of regenerative cooling with a neat diagram.
24. Derive Planck's law of radiation from harmonic oscillators.

Contd....3

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SECTION – D

IV. Answer any TWO questions.

2 x 10 = 20 Marks

25. (a) Define escape velocity of a body. Obtain an expression for it. Write down three conditions of an earth satellite to be stationary.

(b) Calculate the effective weight of an astronaut ordinarily weighing 60kg when his rocket moves vertically up with 5g acceleration. (7 + 3 Marks)

26. (a) Define the modulus of elasticity. Obtain an expression for the couple per unit twist for a wire fixed at one end and twisted at the other.

(b) A Steel wire of radius 1mm is bent into an arc of a circle of radius 50 cm. Calculate its bending moment. Given  $q = 20 \times 10^{10} \text{ Nm}^{-2}$ . (7 + 3 Marks)

27. (a) State and explain the law of equipartition of energy. Obtain an expression for ratio of specific heats for a mono atomic gas.

(b) The Vander Waal's constants for hydrogen are  $a = 0.0247 \text{ Nm}^4 \text{ mole}^{-2}$  and  $b = 2.65 \times 10^{-5} \text{ m}^3 \text{ mole}^{-1}$ . Calculate the temperature of inversion. (7 + 3 Marks)

28. (a) With the help of indicator diagram, obtain an expression for the efficiency of Carnot's engine.

(b) A Carnot's engine whose low temperature reservoir is at  $7^\circ\text{C}$  has an efficiency of 50%. It is desired to increase an efficiency to 70% by how many degrees should the temperature of high temperature reservoir be increased? (7 + 3 Marks)

SECTION – E

V. Answer any one of the following questions.

1 x 10 = 10 Marks

(Compulsory question for 85 marks scheme only)

29. (a) Obtain an expression for radial and transverse components of velocity and acceleration of a particle moving in a plane.

(b) What is black body? Mention any three characteristics of black body spectrum. (6 + 4 Marks)

30. (a) Obtain an expression for work done in isothermal and adiabatic changes.

(b) Derive an expression for Elastic potential energy. (6 + 4 Marks)

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