[This question paper contains 4 printed pages.]

215 *Your Roll No.* .....

B.Sc. Prog. / II **C**

PH-202 – PHYSICS – THERMAL PHYSICS AND OPTICS

(Admissions of 2008 and onwards)

Time : 3 Hours *Maximum Marks : 75*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any **five** *questions.*
Symbols have their usual meanings.

1. (a) State and prove Carnot's theorem. (6)

(b) Using characteristics of a Carnot cycle and Clausius Theorem show that

$$dS = \frac{dQ}{T} \qquad (6)$$

(c) A Carnot's engine whose temperature of the source is 400K takes 200 calories of heat at this temperature and rejects 150 calories of heat to the sink. What is the temperature of the sink ? Also calculate the efficiency of the engine. (3)

P.T.O.

2. (a) What are 'Thermodynamic Potentials ? (3)

(b) Derive Maxwell Relations and discuss their physical significance. (7)

(c) Using Maxwell's relations show

$$\frac{\alpha_s}{\alpha_p} = \frac{1}{1-\gamma} \qquad (5)$$

3. (a) Deduce the Clausius-Clapeyron Equation. What is the effect of pressure change on melting point and boiling point of a substance. (10)

(b) Calculate the change in the boiling point of water when the pressure is increased from 1.0 to 1.2 atmospheres. Given specific volume of steam = 1677 cc/gm, latent heat of steam = 540 cal/gm. Boiling point of water at one atmosphere = 100°C and pressure of one atmosphere = 1.0×10^6 dynes/cm^2. (5)

4. (a) Deduce Maxwell's law of distribution of velocities :

$$dn = na^3 e^{-b(u^2+v^2+w^2)}\, du\,dv\,dw \qquad (9)$$

(b) Determine the constants 'a' and 'b'. (6)

5. (a) Define the terms 'Macro' and 'Micro' states of an ensemble. (3)

(b) Explain the term 'Thermodynamic probability'. (2)

(c) Show that the Thermodynamic Probability for an ensemble obeying Fermi Dirac statistics is given by

$$W_{r_-}^{FD} = \prod_r \frac{g_r!}{N_r!(g_r - N_r)!} \quad (5)$$

(d) Hence deduce the corresponding Equilibrium Distribution Function. (5)

6. (a) Using a broad monochromatic source of light obtain conditions of maxima and minima of intensity of the interference patterns produced by a thin film in its reflected system. (6)

(b) Distinguish between Fresnel and Fraunhofer class of diffraction pattern. (4)

(c) A soap film of refractive index 1.33 is illuminated with light of different wavelengths at an angle of 45°. There is complete destructive interference for λ = 5890 A°. Find the thickness of the film. (5)

7. Attempt any **two** of the following :

(a) Discuss the third law of thermodynamics and unattainability of absolute zero of temperature.

(b) Prove

$$C_p - C_v = -T v \alpha^2 E$$

(c) Deduce the expression for the diffusion coefficient using the principles of kinetic theory of gases.

(d) What is meant by half period zones ? How is rectilinear propagation of light explained on the basis of the wave theory. (7½,7½)