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Your Roll No. ....

263

**B.Sc. (Prog.)/II**

**C**

MP-202 : Thermal Physics and

Electromagnetism

(Admissions of 2005 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.

*All* questions carry equal marks.

1. (a) Explain the working of a Carnot's heat engine for a perfect gas and obtain an expression for its efficiency in terms of sink and source temperatures. 12

P.T.O.

- (b) A Carnot's engine has the same efficiency between 1227°C and 227°C and between  $x^\circ\text{C}$  and  $0^\circ\text{C}$ . Find the value of  $x$ . - 3
2. State Maxwell's law of distribution of velocities. Discuss a method for its experimental verification. Obtain an expression for the most probable speed and average speed. 3.6.6
3. Distinguish between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Obtain an expression for the distribution function corresponding to Maxwell-Boltzmann statistics. 6.9
4. (a) Show that the number of normal modes of vibration per unit volume of an enclosure in the frequency range  $\nu$  and  $\nu+d\nu$  is given by :
- $$N\nu d\nu = \frac{8\pi\nu^2 d\nu}{c^3},$$
- where  $c$  is the speed of light. Use this relation to obtain Planck's law of black body radiation. 7.4

- (b) Starting from Planck's law of radiation, obtain Rayleigh Jeans and Wien's displacement law. 4
5. (a) State Coulomb's law. Define electric field intensity. 22
- (b) State and prove Gauss's law in electrostatics. Obtain its differential form. Obtain an expression for the electric field at a point outside a uniformly charged solid sphere. 6,2,3
6. (a) State and prove Ampere's circuital law. Discuss Maxwell's modification of Ampere's law. 5,5
- (b) State Faraday's law of electromagnetic induction and obtain it in differential form. 5
7. (a) Write down the Maxwell's equations for electromagnetic waves in a free space and also in a dielectric medium. Derive the wave equation satisfied by the electric field. What is Poynting vector ? 3,6,3
- (b) Explain the term skin depth. 3

8. Write short notes on any *two* of the following :  $7\frac{1}{2}, 7\frac{1}{2}$
- (a) First and the second law of thermodynamics
  - (b) Mean free path
  - (c) Thermodynamic potentials
  - (d) Fresnel relations for reflection and refraction.