

**U.G. 6th Semester Examination - 2021**

**PHYSICS**

[HONOURS]

**Course Code : PHY-H-CC-P-14**

**(Statistical Mechanics)**

**[PRACTICAL]**

Full Marks : 20

Time : 2 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

1. Answer any **two** questions: 10×2=20
- a) Derive the expression for the energy density following Planck's theory of black body radiation.
- b) Write down a program to plot the variation of energy density with wavelengths corresponding to absolute temperatures 3000K, 4000K and 5000K for the Planck's theory of cavity radiation. Restrict your plot within wavelength 4000 nm only. 5+5
2. a) Write down a program to compare Planck's quantum theory and Rayleigh-Jeans classical theory of black body radiation on a same plot for absolute temperature 5500K.

- b) Explain the term "Ultraviolet catastrophe". 8+2

3. a) Mention the logical differences between the assumptions made in Einstein's theory and in Debye's theory for the specific heat of solids.
- b) Write a program to plot and compare the specific heats ( $C_V$ ) of a solid as predicted by Einstein's and Debye's theories. Given that: Einstein characteristic temperature ( $T_E$ ) and Debye temperature ( $T_D$ ) are respectively 280K and 480K. 2+8
4. a) Write a program to plot Fermi-Dirac distribution functions for the temperatures 0K, 500K and 1000K. Suppose that the chemical potential of the system is zero and restrict the energy range between  $-0.5$  eV to  $+0.9$  eV in your plot.
- b) The occupation number for a system of Bosons diverges for  $\epsilon = \mu$  at finite T. What phenomenon does this indicate? Does this happen for a system of photons? 7+3
5. a) Show that the FD distribution function reduces to MB distribution function at very high temperature.

[Turn over]

- b) Six Fermions are arranged in two compartments. The first compartment has 7 cells, and the second compartment has 8 cells of equal size. What is the total number of microstates for the macrostate (2,4)?
- c) Discuss in short how Einstein's theory for specific heat of solids helped to shape quantum physics in later years. 2+6+2

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