C 5759 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER P.G. DEGREE (SUPPLEMENTARY) EXAMINATION SEPTEMBER 2021

(CUCSS)

Physics

PHY 2C 07—STATISTICAL MECHANICS

(2012 Syllabus)

Time : Three Hours Maximum : 36 Weightage

Section A

12 Short questions answerable within 7.5 minutes.
Answer **all** *questions, each question carries 2 marks.*

1. State Liouville's theorem. What are its consequences ?
2. Differentiate between distinguishable and indistinguishable particles.
3. Differentiate between μ-space and Γ-space.
4. Define partition function. What is the significance of partition function in statistical mechanics ?
5. What do you mean by a grand canonical ensemble and write an expression for the density function ?
6. How is Bose-Einstein condensation different from the ordinary condensation of a gas in physical space ?
7. State the postulates of equal a priori probability.
8. Why is the electronic contribution to the specific heat of a metal vary with temperature at low temperatures ?
9. Define Fermi energy. What is its significance at (i) T = 0 K (ii) T > 0 K ?
10. Define black body radiation. What are its characteristic properties ?
11. How Maxwell-Boltzmann distribution can be considered as a limiting case of Bose-Einstein distribution ?
12. What do you mean by fluctuations ? When are these fluctuations negligible ?

(12 × 1 = 12 weightage)

Turn over

Section B

2 essay questions answerable within 30 minutes.
Answer any **two** *questions, each question carries 6 weightage.*

1. What is Gibb's paradox ? How is it resolved ?
2. Derive expressions for energy fluctuations in the case of canonical ensemble.
3. Derive Plank's formula for black body radiation using Bose-Einstein statistics. Using the result, deduce Stefan's -Boltzmann law.
4. Explain Pauli Para magnetism and obtain the expression for susceptibility.

(2 × 6 = 12 weightage)

Section C

4 problems answerable within 15 minutes.
Answer any **four** *questions, each question carries 3 weightage.*

1. A system in contact with a heat bath at temperature T has two accessible energy states with energies 0 and 0.1eV. If the probability of the system being in the higher energy state is 0.1 eV, find the temperature of the heat bath.
2. How does the number of microstates of 1 g of H_2 gas change, if its volume gets doubled by a process of reversible adiabatic expansion ?
3. The entropy of a microstate of a system is 1 JK^{-1} while that of another one is 1.001 Jk^{-1}.How many times more likely is the second microstate as compared to the first one ?
4. State and explain equipartition theorem.
5. The density of electron in lithium is $4.7 \times 10^{28} m^{-3}$. Calculate the degeneracy pressure of the electron gas in the metal.
6. Find out the wavelength corresponding to maximum emission by a black body at 500° C. Would you be able to see this radiation ?

(4 × 3 = 12 weightage)

C 5760 (Pages : 2) Name.....

Reg. No.....

SECOND SEMESTER P.G. DEGREE (SUPPLEMENTARY) EXAMINATION SEPTEMBER 2021

(CUCSS)

Physics

PHY 2C 08—COMPUTATIONAL PHYSICS

(2012 Syllabus)

Time : Three Hours Maximum : 36 Weightage

Section A

12 *Short questions answerable within* 7.5 *minutes.*
Answer **all** *questions, each question carries* 1 *mark.*

1. Explain the arithmetic operators in python.
2. What are the collection data types in python ?
3. Comment on the output of python lambda function.
4. Write a program to print all numbers from 0 to 5, and print a message when the loop has ended.
5. Explain the functions that return the matrices filled with zeros and ones.
6. Compare the functions, NumPy array copy and view.
7. Write a program to draw a line from position $(1, 1)$ to position $(7, 10)$.
8. Give the syntax of the function, subplot().
9. State and explain the sampling theorem.
10. What are zeros of polynomial ?
11. Explain the Runge-Kutta (RK4) numerical solution for differential equations.
12. What are the advantages of numerical method over analytical one ?

(12 × 1 = 12 weightage)

Section B

2 essay questions answerable within 30 minutes.
Answer any **two** *questions, each question carries 6 weightage.*

13. Explain the standard trigonometric functions provided in NumPy module.
14. Explain the methods of plotting (i) Exponential ; (ii) Bessel ; and (iii) Gamma functions in Matplotlib.
15. Outline the Monte Carlo method of simple integration.
16. Outline the Euler method to solve simple harmonic oscillator.

(2 × 6 = 12 weightage)

Section C

4 problems answerable within 15 minutes.
Answer any **four** *questions, each question carries 3 weightage.*

17. Write a python program to find the area of a triangle.
18. Write a program in python to check if a given number is prime or not.
19. Using NumPy functions, write a program to find the determinant and the inverse of the matrix,

$$\begin{bmatrix} 6 & 1 & 1 \\ 4 & -2 & 5 \\ 2 & 8 & 7 \end{bmatrix}.$$

20. Explain the scatter plots in matplotlib.
21. Consider the data points : $\{(0,0),(\pi/2,1),(\pi,0)\}$ for the function, $y = \sin x\,;\{0 \le x \le \pi\}$. Determine the cubic splines and evaluate the approximate values of $y(\pi/6)$? [Given $n = 2\,; M_0 = M_2 = 0$].
22. Write a python program to estimate the value of π using Monte Carlo simulation method.

(4 × 3 = 12 weightage)