

2016

PHYSICS

(Major)

Paper : 6.4

(**Statistical Mechanics and
Computer Applications**)

Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

GROUP—A

(**Statistical Mechanics**)

1. Answer the following questions : 1×6=6
- (a) State the Liouville theorem.
 - (b) Define Fermi energy.
 - (c) Which statistics is applicable for nuclei containing odd numbers of nucleons?
 - (d) What is the probability of finding an electron with energy equal to the Fermi energy in a metal at any temperature?

- (e) What is the Boltzmann canonical principle about statistical equilibrium?
- (f) For which type of particles the symmetric wave function is applicable?

2. Answer the following questions :

- (a) Derive most probable distribution in Maxwell-Boltzmann statistics. 3
- (b) Compare between Bose-Einstein and Fermi-Dirac statistics. 3
- (c) What is Bose-Einstein condensation? Write the condition of degeneration. 1+2
- (d) Derive Boltzmann entropy relation. 3

3. Answer any *two* of the following : $6 \times 2 = 12$

- (a) Derive Maxwell's distribution law using M-D statistics.
- (b) What is Fermi distribution function? Apply F-D statistics to derive electronic specific heat.
- (c) Deduce blackbody radiation formula using B-E statistics.

GROUP—B

(Computer Application)

4. Write down the FORTRAN-95 or C or C⁺⁺ expression for the following : 2×3=6

(a)
$$Y = \frac{2x^2 + 3}{3x^2 + 4}$$

(b)
$$e^{x^2} + \frac{3x^3}{1+x^2}$$

(c)
$$Z = \frac{x \sin^{-1} x + 1}{x^3 + \cos^{-1} x}$$

5. Answer the following : 2×2=4

(a) How can you write the input and output statements for an character constant A in either FORTRAN-95 or C or C⁺⁺?

(b) How are the following mathematical functions expressed in FORTRAN-95 or C or C⁺⁺?

(i) Absolute value of $x^2 + 3y^2$

(ii) Logarithm (base 10) of x^3

6. Answer either (a) or (b) :

5

(a) Write down the flow chart and a program in either FORTRAN-95 or C or C⁺⁺ to generate AP series with common difference 2 and number of elements 10 and also find its sum.

(b) Write down the flow chart and a program in either FORTRAN-95 or C or C⁺⁺ to find the sum of N odd numbers.

7. Answer either (a) or (b) :

5

(a) Write a program in either FORTRAN-95 or C or C⁺⁺ to compute the real roots of the following quadratic equation :

$$ax^2 + bx + c = 0 \text{ for } a = 5, b = -8 \text{ and } c = 1$$

(b) Write a program in either FORTRAN-95 or C or C⁺⁺ to determine mean and standard deviation of given experimental data.

8. Answer either (a) or (b) :

10

(a) Write down different steps required to find the numerical solution of a first-order differential equation with the aid of 4th order Runge-Kutta method.

Write a program in either FORTRAN-95 or C or C⁺⁺ to solve the differential equation $\frac{dy}{dx} = 2x^3 + y^2$ in the interval

[1, 1.5] having initial value $y = 0.8$ at $x = 1$ and step size $h = 0.5$ using Runge-Kutta 4th order method. What is the order of error in such method?

- (b) Write down the step-by-step procedure to solve for numerical value of integral using Simpson's one-third rule. Write the flow chart and a program in either FORTRAN-95 or C or C⁺⁺ to compute the numerical value of the integral for $N = 100$

$$\int_0^2 \frac{dx}{2x^2 + 3x}$$

using Simpson's one-third rule.
