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 : 6×2=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) $Y = \dfrac{2x^2 + 3}{3x^2 + 4}$

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

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

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 :

$ax^2 + bx + c = 0$ for $a = 5$, $b = -8$ 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 $y = 0 \cdot 8$ at $x = 1$ and step size $h = 0 \cdot 5$ 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.

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