

2017

PHYSICS

(Major)

Paper : 6.4

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 : 1×4=4
 - (a) State ergodic hypothesis.
 - (b) What is phase space?
 - (c) What is degeneracy of an energy level?
 - (d) Name one particle which can be described by antisymmetric wave function.

2. Answer the following questions : 3×4=12
 - (a) Explain the conditions of validity of classical and quantum mechanics.
 - (b) Derive Boltzmann entropy relation.

- (c) Explain Fermi energy and Fermi temperature.
- (d) Write a short note on 'degeneracy factor'.
3. Answer any *two* of the following : $7 \times 2 = 14$
- (a) Derive Maxwell's velocity distribution law using Maxwell-Boltzmann statistics.
- (b) Derive the probability of distribution in the three statistics.
- (c) Explain BE condensation using BE statistics.

GROUP—B

(**Computer Applications**)

4. How will you write the following in FORTRAN-95 or C or C++ ? $2 \times 3 = 6$
- (a) (i) i is an integer variable whose value is assigned as 3.
- (ii) j is a floating-point variable whose value is assigned as 2.9 and verify whether i is equal to j .
- (b) (i) Declare k as an integer variable whose value is not equal to 0 ($k \neq 0$).
- (ii) Assign n equal to 5 as an integer and then increment as well as decrement n .

(c) Use logical 'AND' and logical 'OR' operator signs for the following :

(i) if (error > 0.01 'AND' count < 100)

(ii) if (i > 2 'OR' j < 1)

5. Write down the FORTRAN-95 or C or C++ equivalent forms for the following expressions :

1×4=4

(a) $Y = x \tan^{-1} x + \sin^{-1} \left(\frac{1}{\sqrt{1-x^2}} \right)$

(b) $Z = \sqrt{\cos x^2 - 2x^2}$

(c) $p = \log x^2 + |x|$

(d) $y^2 + 10x^9 - e^{\log x^2}$

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

5

(a) Write a program in either FORTRAN-95 or C or C++ to find the solution of the following simultaneous linear equations with known coefficients a, b, c, p, q, r :

$$ax + by = c$$

$$px + qy = r$$

Take the coefficients of the two equations as input, develop algorithm to evaluate unknown x and y .

3+2=5

- (b) Write down the flowchart and a program in either FORTRAN-95 or C or C++ to find the greatest of the three given integers a, b, c . 2+3=5

7. Answer either (a) or (b) : 5

- (a) Write a program in either FORTRAN-95 or C or C++ to generate the exponential series e^x and find its sum. 4+1=5

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

$$3x^2 - x - 2 = 0$$

Examine whether roots are real or imaginary. 4+1=5

8. Answer either (a) or (b) : 10

- (a) (i) Write down different steps required to develop the algorithm for numerical solution of a first-order differential equation

$$\frac{dy}{dx} = \sqrt{x+y}$$

in the interval $[1, 1.2]$ having initial value $y=1.4$ at $x=1$ and step size $h=0.2$.

(5)

(ii) Using Runge-Kutta fourth-order method, write down a program in either FORTRAN-95 or C or C++ to compute numerical solution of the equation.

(iii) Estimate the approximate error in such method from the given data.

$$3+5+2=10$$

(b) (i) Write down the general mathematical form needed to compute the approximate numerical solution of a finite size integral $I = \int_a^b f(x) dx$ using Simpson's one-third rule.

(ii) What is the degree of interpolating polynomial used to evaluate numerical integration?

(iii) Using Simpson's one-third rule, write a program in either FORTRAN-95 or C or C++ to find numerical solution of the integral

$$\text{for } N = 20; I = \int_0^1 \frac{1}{1+x^2} dx.$$

$$4+1+5=10$$

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