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 : 7×2=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++ ? 2×3=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 $n$.



( Continued )

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

(i) if (error $> 0 \cdot 01$ '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 $y = 1 \cdot 4$ at $x = 1$ and step size $h = 0 \cdot 2$.

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

4+1+5=10

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