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PHYSICS

(Major)

Paper : 4.1

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks
for the questions

GROUP—A

(Mathematical Methods—IV)

(Marks : 40)

1. Answer any *four* of the following questions :

    1×4=4

   (a) What is singular point in a second-order linear differential equation?

   (b) The function $\{1 - 2xh + h^2\}^{-1/2}$ is known as generating function of Legendre polynomial. Why?

   (c) Mention an application of Hermite polynomial which is used in physics.

(Turn Over)

(d) Find the value of

$$\frac{2}{5} P_3(x) + \frac{3}{5} P_1(x)$$

(e) The word UNIVERSITY is arranged randomly. Find the probability that both I do not come together.

(f) What is Gaussian distribution?

2. Answer any *three* of the following questions :

2×3=6

(a) What is the value of $P_{2n+1}(x)$?

(b) What is the value of

$$\int_{-1}^{+1} x^n P_n(x) \, dx \ ?$$

(c) A card is drawn from a well shuffled pack of playing cards. Find the probability that it is either a king or a spade.

(d) Define total probability.

3. Answer any *two* of the following questions :

$$5 \times 2 = 10$$

(a) From the value of Legendre polynomial, prove that

$$x^2 = \frac{1}{3}[2P_2(x) + P_0(x)]$$

(b) Find the indicial equation of the Hermite equation

$$\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2xy = 0$$

(c) Determine the probable error for the Gaussian distribution and express it as a multiple of σ.

(d) Define mean and standard deviation.

4. Answer any *two* of the following questions :

$$10 \times 2 = 20$$

(a) (i) Use Frobenious method to find the series solution of the equation

$$\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 + 2)y = 0$$

5

(ii) Find the degree and order of the following equation : 5

$$\frac{d^2 y}{dx^2} + \frac{2}{x}\frac{dy}{dx} + \frac{81}{x^4} = 0$$

(b) (i) Write the generating function for Hermite polynomial $H_n(x)$ and prove that

$$H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} e^{-x^2}$$

5

(ii) Prove that

$$\int_{-\infty}^{+\infty} e^{-x^2} H_m(x)\, H_n(x)\, dx = 0$$

if $m \neq n$. 5

(c) (i) Legendre polynomials $P_n(x)$ are defined by the generating function

$$g(x, t) = (1 - 2xt + t^2)^{-\frac{1}{2}} = \sum_{n=0}^{\infty} P_n(x) t^n \quad |t| < 1$$

Hence prove that

$$(2n + 1) x P_n(x) = $$
$$(n + 1) P_{n+1}(x) + n P_{n-1}(x) \quad 6$$

(ii) Prove the following recurrence relation :   4

$$2x\, H_n(x) = 2n\, H_{n-1}(x) + H_{n+1}(x)$$

(d)   *(i)* What is the standard deviation of the following series?   5

Measurement :	0–10	10–20	20–30	30–40
Frequency :	1	3	4	2

(ii) Given $P(A) = \dfrac{1}{2}$, $P(A \cup B) = \dfrac{3}{5}$ and $P(B) = p$. Find the value of p if A and B are mutually exclusive and independent.   5

GROUP—B

**(Introduction to Computer and
Computer Programming)**

(*Marks* : 20)

5. Answer any *three* of the following questions :

$1 \times 3 = 3$

(a) Define a 'computer word'.

(b) Write down the FORTRAN95/C/C++ expression for the algebraic expression

$$y = e^x + \tan^{-x} + x^2$$

(c) Write the statement in FORTRAN95/C/C++ to display 'Welcome to Guwahati'.

(d) What is a string?

6. Answer any *one* of the following questions :   2

(a) What is an array? Write down the syntax for declaration of a non-dimensional array in either FORTRAN95/C/C++.

(b) Write down the syntax in FORTRAN95/C/C++ for any two repetition control statements.

(c) What are the advantages and disadvantages of assembly language?

7. Answer any *one* of the following questions :   5

   (a) Write the algorithm and draw the flowchart to find the area of a triangle.

   (b) Describe any two functional units of a computer.

8. Answer any *one* of the following questions :   10

   (a) Draw the flowchart and write the program in FORTRAN95/C/C++ to generate and find the sum of first *n* natural numbers.   5+5=10

   (b) Write the algorithm and draw the flowchart to find out whether a given number is prime or not.   5+5=10

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