

2 0 1 4

PHYSICS

( Major )

PAPER : 4.1

Full Marks : 60

Time : 2½ hours

The figures in the margin indicate full marks  
for the questions

GROUP—A

1. Answer any four of the following questions : 1×4=4

(a) If  $P_n(x)$  and  $Q_n(x)$  are two independent solutions of Legendre equation, then write the general solution of the Legendre equation.

(b) If  $\int_{-1}^{+1} P_n(x) dx = 2$ , then  $n$  is

(i) 1

(ii) 0

(iii) -1

(iv) None of the above

(Choose the correct answer)

- (c) Define standard deviation.
- (d) If  $P_n(x)$  be the Legendre polynomial, then find the value of  $P'_n(x)$ .
- (e) What do you mean by Gaussian distribution curve?
- (f) Give an example where Hermite polynomial is used in physics.

2. Answer any *three* of the following questions : 2×3=6

- (a) What is the value of  $P_{2n}(0)$ ?
- (b) Check the following equation whether Frobenius method can be applied or not :

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

- (c) By using the theorem of compound probability, find the probability of all heads in three tossing of coin.
- (d) Find the degree and order of the following equation :

$$\frac{d^2y}{dx^2} + \frac{2}{x} \cdot \frac{dy}{dx} + \frac{9^2}{x^4} = 0$$

- (e) Prove that

$$H_{2n}(0) = (-1)^n \cdot 2^{2n} \cdot \left(\frac{1}{2}\right)_n$$

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

- (a) (i) Why is the function  $(1 - 2xh + h^2)^{-\frac{1}{2}}$  known as a generating function of Legendre polynomial? 1

(ii) Show that

$$(1 - 2xh + h^2)^{-\frac{1}{2}} = \sum_{n=0}^{\infty} P_n(x) h^n$$

where  $P_n(x)$  is the Legendre polynomial. 4

- (b) Evaluate explicitly the Legendre's polynomials  $P_2(x)$  and  $P_3(x)$ .  $2\frac{1}{2} + 2\frac{1}{2} = 5$

(c) Show that

$$\int_{-\alpha}^{+\alpha} e^{-x^2} H_m(x) H_n(x) dx = 0, \text{ if } m \neq n \quad 5.$$

- (d) State and prove the theorem of total probability. 5

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

- (a) Write the indicial and recurrence relations for the differential equation

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

Also find the solution of the equation by using Frobenius method of solution.

$$2 + 2 + 6 = 10$$

- (b) (i) A player tosses a coin and is to score one point for every head turned up and two for every tail. He is to play until his score reaches or passes  $n$ . If  $P_n$  is his chance of attaining exactly  $n$ , show that

$$P_n = \frac{1}{2}(P_{n-1} + P_{n-2})$$

Hence find the value of  $P_n$ . 5

- (ii) Find the standard deviation for the following frequency distribution : 5

Class Interval :	0-4	4-8	8-12	12-16
Frequency :	4	8	2	1

- (c) (i) Prove the following recurrence relation : 5

$$2nH_{n-1}(x) = H'_n(x)$$

- (ii) Write the generating function for Hermite polynomial  $H_n(x)$  and hence show that

$$H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} e^{-x^2} \quad 5$$

- (d) (i) State and prove the orthogonality of Legendre's polynomial. 6

- (ii) If  $P_n$  is the Legendre's polynomial, then use generating function to derive the following relation : 4

$$nP_n(x) = xP'_n(x) - P'_{n-1}(x)$$

GROUP—B

5. Answer any *two* of the following questions :  $1 \times 2 = 2$

- (a) What is the difference between RAM and ROM?
- (b) What is the output of  $A / B$  and  $A \% B$  ?
- (c) Define an array.

6. Answer any *two* of the following questions :  $2 \times 2 = 4$

- (a) What are the characteristics of machine language?
- (b) What are the advantages of breaking a program into subroutines?
- (c) Write a syntax in C/C++/FORTRAN of any one repetition control statement.

7. Answer any *one* of the following questions : 4

- (a) Draw a flowchart to find out the roots of a quadratic equation.
- (b) Write a program in C/C++/FORTRAN to find out the greatest of three numbers.

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

(a) Write the algorithm and draw the flow-chart to find out the prime numbers from a set of given numbers.  $5+5=10$

(b) Write the algorithm and draw the flow-chart to find out the odd and even numbers from a given set of numbers.  $5+5=10$

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