

**3 (Sem-4) PHY M 1**

**2017**

**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) Write a second-order, second-degree differential equation.

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

- (c) What is meant by mean deviation?
- (d) Write the Hermite equation that can be solved by the power series method, where there is no singularity in the finite plane.
- (e) What is total probability?
- (f) Give an example where solution of Legendre differential equation is used.

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

2×3=6

- (a) Prove that  $P_n^m(-x) = (-1)^{m+n} P_n^m(x)$ .
- (b) Check whether Frobenius method can be applied or not to the following equation :

$$2x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} + (x-5)y = 0$$

- (c) Calculate the probability of obtaining 4 heads in 6 tosses using an unbiased coin.
- (d) Explain briefly Gaussian distribution.

(e) Prove the following recurrence relation :

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

(f) Show that  $P_n(1) = 1$ .

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

5×2=10

(a) Prove that

$$\int_{-1}^{+1} x P_n(x) P_{n-1}(x) dx = \frac{2n}{4n^2 - 1}$$

(b) Find the indicial equation of the following Hermite equation :

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

(c) Find the probability that in 100 tosses of a coin, we get between 45 and 55 heads.

(d) If the solution  $y(x)$  of Hermite's differential equation is written as

$$y(x) = \sum_{r=0}^{\infty} a_r x^{k+r}$$

then show that the allowed values of  $k$  are zero and one only.

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

10×2=20

(a) (i) Show that

$$\int_{-1}^{+1} P_n(x) P_m(x) dx = 0$$

where  $P_n(x)$  and  $P_m(x)$  are solutions of the Legendre differential equation.

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(ii) Prove the following recurrence relation :

4

$$n P_n = (2n-1)x P_{n-1} - (n-1)P_{n-2}$$

(b) (i) Show that the generating function for Hermite polynomial  $H_n(x)$  for integral  $n$  and real values of  $n$  is given by

$$e^{2xt-t^2} = \sum_{n=0}^{\infty} \frac{t^n}{n!} H_n(x)$$

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(ii) Prove the following recurrence relation :

4

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

(c) (i) What do you mean by variance? 1

(ii) What is a normal curve and under what condition a normal curve becomes a normal distribution? 1+2=3

(iii) Define standard deviation. In a project, the height of 5 cats are found as 60 mm, 47 mm, 30 mm, 43 mm and 20 mm. Find the standard deviation. 1+4=5

(iv) Define mutually exclusive events. 1

(d) (i) Solve by power series method, the following equation : 5

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

(ii) Identify the singular points of the Legendre differential equation

$$(1 - x^2) \frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} - n(n+1)y = 0;$$

$n = \text{constant}$

Obtain the general series solution near  $n = 0$ . 5

GROUP—B

( Introduction to Computer and  
Computer Programming )

( Marks : 20 )

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

1×3=3

- (a) Define a flowchart.
- (b) What is a string?
- (c) What is word length of the computer?
- (d) What is the standard input stream in C / C++ / FORTRAN to access the keyboard?

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

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- (a) What are the differences between machine language and high-level language?
- (b) What are different types of logical operations in C / C++ / FORTRAN?
- (c) Give a typical declaration for an array in C / C++ / FORTRAN.

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

(a) Write an algorithm to find whether a given number is odd or even.

(b) Write a program in C / C++ / FORTRAN to find the compound interest.

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

(a) Write the algorithm and draw the flowchart to find the roots of a quadratic equation.

(b) Write the algorithm and the program in C / C++ / FORTRAN to find the sum and average of first  $n$  natural numbers.

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