# 2016

## M.Sc. Part–I Examination

## PHYSICS

### PAPER—V

*Full Marks* : 75

*Time* : 3 Hours

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*Illustrate the answers wherever necessary.*

***Use separate Answerscripts for Gr. A & Gr. B.***

### Group—A

[ Marks—35 ]

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

(a) Evaluate $\Delta^n\left(e^x\right)$.

(b) Find the absolute, relative and percentage error in $x_A$

when $x_T = \frac{1}{3}$ and $x_A = 0{\cdot}333$.

(c) What are the uses of the command LIST and DISPLAY ?

(d) Write the syntax of subroutine subprogram.

(e) Write the syntax of Function subprogram.

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

(a) Write a program to find a real root of the equation $x^3 - x - 1 = 0$ by Newton-Raphson method.

(b) Write a program to find the largest among four given numbers.

(c) Write a program to compute the square and cube of a square matrix.

(d) Write a program to compute the value of n !





(e) Write a program to compute the function y (x) defined as :

$$y(x) = 15x + 7{\cdot}4 \quad \text{when } x \le 6{\cdot}5.$$
$$= 17x \quad \text{when } x > 6{\cdot}5.$$

3. Answer any *four* questions : 4×5

(a) Find the largest eigen value of the following matrix

$$A = \begin{pmatrix} 3 & 4 & -1 \\ 1 & 2 & 0 \\ 2 & 5 & 1 \end{pmatrix}$$

With initial vector $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$.

(b) Find the inverse of the matrix $\begin{pmatrix} 1 & 2 & 5 \\ 3 & 0 & 1 \\ -1 & 1 & 3 \end{pmatrix}$ by Gauss – Jordan method.

(c) Using the method of least squares, find the values of x and y from the following :

$x + y = 3{\cdot}0,\ 2x - y = 0{\cdot}03,\ x + 3y = 7{\cdot}03$ and $3x + y = 4.97$.

(d)

| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| y | 1 | −1 | 1 | −1 | 1 | – | – | – |

Find $y_5, y_6, y_7$.

(e) Using Runge-Kutta method of fourth order, solve

$\frac{dy}{dx} = xy + y^2$ given that $y(0) = 1$, Take $h = 0{\cdot}2$ and find

y at $x = 0{\cdot}2,\ 0{\cdot}4,\ 0{\cdot}6$.

(f) Evaluate the using Simpon's $\frac{1}{3}$ rule

$$\int_0^{\pi/2} \frac{dx}{\sin^2 x + 2\cos^2 x}.$$





## Group—B

[ Marks—40 ]

Answer Q. No. *1* and any *three* from the rest.

1. Answer any *five* bits : 5×2

(a) Prove that $|z-1| < |z+1|$ implies $\text{Re}(z) > 0$.

(b) Evaluate $\int_C \frac{dz}{\left(z^2+4\right)^2}$ where $C : |z - i| = 2$

(c) Find the Laplace transform of f (t)

defined by $f(t) = t/\tau$ when $0 < t < \tau$

$= 1$ when $t > \tau$.

(d) Find the Laplace transforms of $\delta(t-a)$.

(e) Prove that $P'_{2n}(0) = 0$.

(f) Prove that : $H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n}\left(e^{-x^2}\right)$

(g) Write down the orthogonality relation of irreducible representations in group theory.

2. (a) Find the Fourier Cosine transform of $f(x) = \frac{1}{1+x^2}$ and hence derive Fourier sine transform of $\phi(x) = \frac{x}{1+x^2}$.

(b) Using residue theory, Prove that $\int_0^\infty \cos x^2 \, dx = \frac{1}{2}\sqrt{\frac{\pi}{2}}$.

3. (a) Prove that $\int_{-1}^{+1} x P_n(x) P_{n-1}(x) \, dx = \frac{2n}{4n^2-1}$

(b) Prove that $\int_{-\infty}^{+\infty} x^2 e^{-x^2} H_n^2(x) \, dx = \sqrt{\pi}\, 2^n n! \left(n + \frac{1}{2}\right)$





(c) Prove that : $xL'^{(x)}_n = nL_n - n L_{n-1}$ 3+3+4

4. (a) Solve :

$f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre polynomials.

(b) A capacitor C is connected in series to a resistance R and is connected to a voltage V(t) given by.

$v(t) = v_0$ for $a < t < b$

= 0 otherwise.

Find the current in the circuit as a function of time using method of Laplace transform. 4+6

5. (a) Evaluate the symmetry elements of a square.

(b) Find the matrix reprentation of the above symmetry elements using a proper basis. 5+5

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