May 2025
M.Sc.
Fourth Semester
CORE – 11
PHYSICS
Course Code: MPHC 4.11
(Computational Physics)

Total Mark: 70   *Pass Mark: 28*
Time: 3 hours

Answer <u>five</u> questions, taking <u>one</u> from each unit.

UNIT–I

1. (a) Using Newton-Raphson method, find the real root of the
        equation $3x = \cos x + 1$, correct up to four decimal places.   8
    (b) Find the relative error if the number $x = 0.004997$ is $3 \times 2 = 6$
        (i)   truncated to three decimal places
        (ii) rounded off to three decimal places

2. (a) Using the bisection method, find the root of the equation
        $x^3 - x^2 - 1 = 0$, correct to three decimal places.   7
    (b) Find the missing term in the table using finite difference table 7

x	2	3	4	5	6
y	45.0	49.2	54.1	…	67.4

UNIT–II

4. (a) Apply Gauss-Seidel iteration method to solve the equation   8
        $$20x + y - 2z = 17$$
        $$3x + 20y - z = -18$$
        $$2x - 3y + 20z = 25$$
    (b) Find the eigenvalues and eigenvectors of the matrix
        $$A = \begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$$ 6

3. (a) What are the pitfalls of Gauss elimination method? Solve the following set of linear equations by Gauss-Jordan method   2+8=10

$$3x + 6y + z = 16$$
$$2x + 4y + 3z = 13$$
$$x + 3y + 2z = 9$$

(b) Covert the following set of equations into matrix form and carry out the partial pivoting   4

$$-3a + 5b + 6c + 2d = 11$$
$$15a + 7b + 6c - 4d = 65$$
$$8a + 12b + 20c + 6 = 60$$
$$3a + 4b + 7c + 9d = 7$$

UNIT–III

5. (a) For the following data, prepare a forward difference table and using Newton's forward difference formula, find the value of y for $x = 8.2$ 7

x	2	3	4	5	6	7	8	9
y	−14	4	40	100	190	316	484	700

(b) The velocity u of water flowing over flat surface is measured at several distances y away from the surface. Fit the curve $u = ay^2 + by + c$, using the least squares criterion.   7

y(cm)	0	1	2	3	4
u(cm/s)	0	5	15	3	50

6. (a) Find the cubic polynomial which takes the following values and evaluate $f(4)$ 7

x	0	1	2	3
$f(x)$	1	2	1	10

(b) Fit a straight line to following data using least square fit method   7

x	6	7	7	8	8	8	9	9	10
y	5	5	4	5	4	3	4	3	3

UNIT–IV

7. (a) Evaluate the value of integration $I = \int_{\frac{\pi}{4}}^{\frac{3\pi}{8}} (\sin x)\,dx$. Using the trapezoidal rule with

   (i) stripe width $= \dfrac{\pi}{32}$

   (ii) number of stripes $= 6$

   Compare the answer with analytical answer and determine the error. 6+2+2=10

   (b) Estimate the integration $f(x) = \int_{2.2}^{3.4} (x^3 - 2x^2 + 7x - 5)\,dx$ using Simpson's 1/3 rule assuming 8 stripes. 4

8. (a) Using Newton's forward difference formula, find $\dfrac{dy}{dx}$ and $\dfrac{d^2y}{dx^2}$ at $x = 1.1$ for the following data 6+2=8

x	1	1.1	1.2	1.3	1.4	1.5	1.6
y	7.989	8.403	8.781	9.129	9.451	9.75	10.031

   (b) Evaluate $\int_{-1}^{+1} \dfrac{dx}{1+x^2}$ using Gauss formula for $n = 2$ and $n = 3$.

   3+3+6

UNIT–V

9. (a) Solve $\dfrac{dy}{dx} = 3x + \dfrac{y}{2}$ with $y(0) = 1$, $h = 0.1$, using the 2nd order Runge-Kutta method. 5

   (b) Solve $\dfrac{dy}{dx} = \dfrac{y - x}{y + x}$ using Euler's method to find y at $x = 0.1$.

   Given, $y(0) = 1$ and $h = 0.02$. 9

10. Solve the Laplace's equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown by Jacobi's method.   14

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