2022
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) Round off the numbers 865260 and 37.46235 to four significant figures and compute absolute, relative and percentage error.   7
    (b) Find the root of the following equation correct to 3 decimal places by using bisection method: $x^3 - x - 4 = 0$ 7

2. (a) Use Newton-Raphson method to obtain a root correct to three decimal place of the following equation: $x^3 - 5x + 3 = 0$ 7
    (b) Find the number of terms of the exponential series such that their sum gives the value of e^x correct to six decimal places at $x = 1$.   7

UNIT–II

3. (a) Solve the following set of equations for five iterations using Jacobi's method:

    $$2x + 3z = 4$$
    $$5y + 2z = 3$$ 7
    $$5x + 4y + 10z = 2$$

    (b) Find the eigenvalues and eigenvectors of the matrix $\begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$ 7

4. (a) Solve the following set of equations by Gauss-Jordan method.

$$x + y + z = 9$$
$$2x - 3y + 4z = 13$$
$$3x + 4y + 5z = 40$$

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(b) Find the eigenvalues and eigenvectors of the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ 7

UNIT–III

5. (a) The velocity 'u' of water flowing over flat surface is measured at several distance 'y' away from the surface. Fit the curve

$u = ay^2 + by + c$ by using least square criteria.

y(cm)	0	1	2	3	4
u(m/s)	0	5	15	30	50

(b) Find the polynomial $f(x)$ by using Lagrange's formula and hence

find $f(3)$ for

x	0	1	2	3
f(x)	2	3	12	147

6. (a) The dynamic viscosity of water $\mu \left(10^{-3} \, Ns / m^2\right)$ is related to the temperature T(°C) in the following manner:

T	0	5	10	15	20	25	30
μ	1.787	1.519	1.307	1.170	1.002	0.8990	0.7975

By using least square criteria, fit above data points in parabolic equation.   7

(b) In the table below, the values of y are consecutive terms of a series. Find the value of y for x = 1 and x = 10 using Newton's interpolation formula.

x	3	4	5	6	7	8	9
y	4.8	8.4	14.5	23.6	36.2	52.8	73.9

UNIT–IV

7. (a) Estimate the value of $\int_{\frac{\pi}{4}}^{\frac{3\pi}{8}} \sin x\, dx$ using trapezoidal rule with strip

    width $\dfrac{\pi}{32}$ and number of strips 6.   8

    (b) Estimate $\int_{0}^{1} \dfrac{1}{x+2}\, dx$ using Gauss quadrature two point formula.   6

8. Estimate the integration $f(x) = \int_{2.2}^{3.4} \left(x^3 - 2x^2 + 7x - 5\right) dx$ assuming 8

    strips using Simpson's 1/3 rule and compare the result for errors with the analytical solution.   14

UNIT–V

9. (a) Find $y(2.2)$ by using Euler's method for $\dfrac{dy}{dx} = -xy^2$, where

    $y(2) = 1$ with $h = 0.1$.   8

    (b) Solve $\dfrac{dy}{dx} = -2xy^2$ with $y(0) = 1$ and $h = 0.01$ for interval 0 to 0.5,

    using Runge-Kutta 4th order method.   6

10. Solve $\dfrac{\partial^2 u}{\partial x^2} + \dfrac{\partial^2 u}{\partial y^2} = 0$ for the following figure by Gauss-Sidel method.

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