2023
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) Explain truncation and round off error with examples.   3
   (b) An approximate value of π is given by 3.14278152 and its true value is 3.14159265. Find the absolute and relative errors in the value of π.   3
   (c) Find the real roots of the equation $x^2 - 4x + 2 = 0$, using false position method up to 3 decimal accuracy.   8

2. (a) Find the roots of the equation $x^2 + 4\sin x = 0$, using Newton-Raphson method up to 3 decimal accuracy.   8
   (b) Given $f(x) = x^3 - 3x^2 + 5x - 10 = 0$. Find the Taylor series approximation of order 0 to 3 at $x = 1$.   6

UNIT–II

3. (a) Solve the following systems of equations using Gauss -Jordan elimination method:
   $x + 2y + z = 8;\ 2x + 3y + 4z = 20;\ 4x + 3y + 2z = 16$ 8

   (b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ 6

4. (a) Solve the following set of equations by $7{\times}2{=}14$
   (i) Jacobi's method
   (ii) Gauss-Seidel method (take 5 iterations)
   $4x + 2z = 4;\ 5 + 2z = 3;\ 5x + 4y + 10z = 2$

UNIT–III

5. (a) Determine the value of y for $x = 1.2$ from the following data: 7

x	0	2	4	6	8
y	−77.5	−69.7	51.5	15.5	169.7

(b) Fit a second order polynomial to the following data: 7

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

6. (a) Using the values in the given table, find $\cos(0.28)$ by linear interpolation and quadratic interpolation. Compare the result with the value 0.96100 (exact value). 3+3=6

x	$f(x) = \cos x$
0.0	1
0.2	0.98007
0.4	0.92106

(b) If the relation between x and y is of the type $y = a.b^x$, using the following values of x and y, find the value of a and b for the best fit curve. 8

x	2.1	2.5	3.1	3.5	4
y	5.14	6.708	10.29	13.6	21

UNIT–IV

7. (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

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) Determine integration of the following function using Simpson's $3/8^{th}$ rule taking 12 stripes between the limits $I = \int_{1.3}^{2.5} (x + 2\sin x)dx$

Compare the error in numerical integration with respect to analytical solution. 6+2=8

8. (a) Evaluate the integral $I = \int_0^1 \frac{1}{x+2} dx$, using

    (i) Gauss quadrature two point formula

    (ii) Gauss quadrature three point formula

    Determine the error for each with respect to analytical integration.

                                        6+6+1+1=14

UNIT–V

9. (a) Evaluate $y(0.1)$ correct up to 4 decimal place using Taylor series

    method, if $\frac{dy}{dx} = x^2 + y^2$; where $y(0) = 1$.   7

   (b) Find $y(0.2)$ by using Euler's method for $\frac{dy}{dx} = -x^2.y$, where

     $y(2) = 1$ and consider $h = 0.1$.   7

10. (a) Solve the Poisson's equation $\frac{\partial^2 u}{\partial x^2} = -10(x^2 + y^2 + 10)$ over the

    square of the sides $x = y = 0$ to $x = y = 3$ with $u = 0$ on boundary
    and mesh size $= 1$.   14

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