BACHELORS WITH PHYSICS AS MAJOR
7th SEMESTER

PHY722J3 PHYSICS _ COMPUTATIONAL PHYSICS

CREDITS: THEORY – 4, PRACTICAL - 2

THEORY (4 CREDITS: 60 HOURS)

LEARNING OUTCOMES:

The learning outcomes cover a wide range of topics in C programming and numerical analysis/numerical methods, providing students with a strong foundation in both programming and numerical problem-solving skills.

1. *Understand the fundamentals of C programming.*
2. *Describe various data types available in C.*
3. *Define constants and variables and understand how to declare them.*
4. *Formulate and evaluate expressions in C.*
5. *Compose statements and understand their role in program flow.*
6. *Utilize library functions for common programming tasks.*
7. *Implement data input and output operations in C programs.*
8. *Work with arrays, character arrays, and strings in C.*
9. *Understand recursion and its application in C programming.*
10. *Design and structure C programs effectively.*
11. *Master the concept of pointers and their declaration.*
12. *Create arrays of pointers for managing data efficiently.*
13. *Define user-defined data types in C.*
14. *Manage files and perform file I/O operations in C.*
15. *Understand the principles of numerical analysis.*
16. *Perform interpolation using the Lagrange interpolation formulation.*
17. *Apply finite differences, including forward and backward differences.*
18. *Utilize Newton's formula for interpolation.*
19. *Apply finite difference methods for numerical differentiation.*
20. *Perform numerical integration using the trapezoidal and Simpson's rule.*
21. *Solve first-order differential equations using the Taylor method.*
22. *Implement the Euler method for solving differential equations.*
23. *Utilize the Runge-Kutta method for solving differential equations accurately.*

UNIT-I (15 HOURS)

C - programming, Programme Characteristics, C character set, identifiers and key words, Data types, Constants, Variables and Arrays Declaration, Expressions, Statements, Symbolic constants, Operators and Expressions, Library functions, Data input and output.

UNIT-II (15 HOURS)

Arrays, Character Arrays and Strings, User defined functions, Function properties, Recurrsion, Programme Structure, Structure and Unions, Pointers, Pointer Declaration, Operation on pointers, Pointers and one-dimensional arrays, Arrays of pointers, User defined data types, File management in C.

UNIT-III (15 HOURS)

Numerical analysis: interpolation, Lagrange interpolation formulation. Finite difference, Forward and Backward differences, Newton's formula, Symbolic relations and separation of symbols, detection of errors by using difference tables.

UNIT-IV (15 HOURS)

Numerical methods: differentiation, finite difference method, Integration by trapezoid and Simpson's rule, solve first order differential equations using Taylor, Euler and Runge-Kutta method.

PRACTICAL (2 CREDITS: 60 HOURS)

1. Linear Equations by Bisection method using C.
2. Complex roots of quadratic equation using C.
3. Matrix addition and Multiplication using C.
4. Matrix Inversion using C.
5. Eigen-Values and Eigen-Vectors using C.
6. Numerical Differentiation and Integration using C.
7. Second order differential equation by Runge-Kutta method using C.

TEXT BOOKS:

1. C Programming for the Absolute Beginner, Second Edition" by Michael Vine, Pearson.
2. Numerical Methods for Engineers" by Steven C. Chapra. McGraw Hills.
3. Numerical Recipes in C: The Art of Scientific Computing, Foundation Books.
4. Numerical Computation Using C , Robert Glassey and Werner Rheinbold**t,** Academic Press