ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-2023
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE PAPER I: OPERATIONS RESEARCH -1

CREDIT: 5
Max. Marks 40
Min. Marks 14

COURSE OBJECTIVE:

The course aspires to make students understand, apply design and evaluate different types of Linear Programming Problems in Operations Research.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1: Comprehend the origin, development, characteristics, phases and applications of Operations Research.

CLO2: Design a LPP in real world objective and evaluate an optimal solution for the linear programming problem by graphical and simplex method

CLO3: Correlate LPP to its corresponding dual LPP and evaluate by simplex, two-phase and Big-M method.

CLO4: Frame and solve transportation problems.

CLO5: Analyze and evaluate replacement problems.

Unit-I: Operations Research and its scope. Origin and Development of Operations Research, Characteristics of Operations Research, Phase of Operations Research, Uses of Operations Research, Role of Operations Research in Decision Making.

Unit-II: Linear Programming Problem, Mathematical Formulation of the Linear Programming Problem, Solution of LPP by Graphical method, Solution of LPP by Simplex method.

Unit-III: Solution of a Linear Programming Problem by Big-M method, Solution of LPP by Two phase method, concept of duality, Advantages of duality, Dual simplex method, Primal of dual Correspondence.

Unit-IV: Transportation problem, Initial basic feasible solution by North-West Corner Rule, Row Minima Method, Column Minima Method, Matrix Minima Method and Vogel's Approximation method, Optimality test by MODI method, Degeneracy in Transportation Problem, Unbalanced Transportation problem .

Unit-V: Replacement problem: Replacement Policy Theorem, Concepts: Money Value, Present worth factor discount, Replacement problem when money value is constant / money value changes with Time, Individual replacement, and Group replacement.

Text Books:

1. S.D. Sharma; Operations Research.

Reference Books:

1. K. Swarup, P. K. Gupta and Manmohan; Operations Research, Sultan Chand & Sons, New Delhi.
2. H. Hadley; Linear and Dynamic programming, Addison-Wesley Reading Mass.
3. F.S. Hiller and G.J. Lieberman; Industrial Engineering Series, 1995.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE PAPER II : SPECIAL FUNCTIONS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To make the students see and understand the gamma, beta function and also hypergeometric, Bessel, Legendre and Hermite differential equations.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO 1 Explain the applications and the usefulness of the gamma and beta functions

CLO 2 Understand Hypergeometric function and their properties.

CLO 3 Gain the concept of Bessel differential equations along with the corresponding recurrence formulas of different functions.

CLO 4 Perform operations Legendre differential equations along with the corresponding recurrence formulas, orthogonal property of different functions.

Unit I Gamma and Beta Functions : The Euler or Mascheroni Constant γ, Gamma Function, A series for $\Gamma'(z) / \Gamma(z)$, Difference equation $\Gamma(z+1) = z\Gamma(z)$, Euler's integral for $\Gamma(z)$, Beta function, value of $\Gamma(z)\,\Gamma(1-z)$, Factorial Function, Legendre's duplication formula, Gauss multiplication theorem, Relations between functions of z and $1-z$.

Unit - II Hypergeometric and Generalized Hypergeometric functions: Function 2F1 (a,b;c;z) A simple integral form evaluation of 2F1 (a,b;c;z) Contiguous function relations, Hyper geometrical differential equation and its solutions, F (a,b;c;z) as function of its parameters, Elementary series manipulations, Simple transformation,

Unit-III Bessel function , Definition of Jn (z), Bessel's differential equation, Generating function for Jn (z), Recurrence Relations for Jn (z), Bessel's integral with index half and an odd integer, Orthogonality of Bessel Functions .

Unit-IV Generating function for Legendre polynomials , Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of Pn (x) , Special properties of Pn(x), Some more generating functions, Laplace's first integral form, Orthogonality.

Unit-V Hermite polynomial : Definition of Hermite polynomials Hn(x), Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Orthogonality, Expansion of polynomials, more generating functions..

Books Recommended ;

1 Rainville, E.D, ; Special Functions, The Macmillan co., New york 1971,
2 Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
3 Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.

Reference Books.

1 Lebdev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
2 Whittaker, E.T. and Watson, G.N., A Course of Modern Analysis Cambridge University Press, London, 1963.

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DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE PAPER III : NUMERICAL METHODS I

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Understand the numerical methods and their analysis for solving different types of linear and non-linear systems.

COURSE LEARNING OUTCOMES:

Upon completion of the course, Students will be able to

CLO 1 Solve Hermite Piecewise Interpolation, Piecewise Linear interpolation, Quadratic interpolation, Cubic Interpolation, Piecewise Cubic Interpolation using Hermite Type Data.

CLO 2 Understand Cubic Spline Interpolation, Bivariate Interpolation and Lagrange Bivariate Interpolation.

CLO 3 Understand Euclidean Norm and Uniform for Discrete Data and Continuous Data,

CLO 4 Find Least Square approximation, Legendre Polynomial and ChebeschevPolynomials Approximation.

CLO 5 Understand Numerical Differentiation, Method Based on Interpolation and Method Based on Finite Differences.

UNIT – I :

Hermite Interpolation Piecewise Interpolation, Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise Cubic Interpolation, Piecewise Cubic

Interpolation using Hermite Type Data, spline interpolation, Quadratic spline interpolation.

UNIT – II :

Cubic spline interpolation, Natural Spline, Bivariate interpolation, Lagrange Bivariate interpolation, Newton's Bivariate interpolation for Equispaced Points.

UNIT III :

Approximation, L^p Norm, Euclidean Norm and Uniform Norm for Discrete Data and Continuous Data, Least squares Aproximation, Gram-Schmidt Orthogonalizing Process, Legendre Polynomials, Chebyshev Polynomials.

UNIT IV : Uniform Approximation, Uniform (minimax) Polinomial Approximation (Chebyshev Approximation), Chebyshev Polynomials Approximation and Lanczos Economization, Rational Approximation , Choice of the method.

UNIT V : Numerical differentiation, Method Based on Interpolation, Non-uniform Nodal Points (Linear Interpolation, Quadratic Interpolation), Uniform Nodal Points (Linear Interpolation, Quadratic Interpolation), Method Based on Finite Differences, Method Based on Undetermined Coefficients, Optimum choice of step length.

Text Book :

Numerical Method for scientific and Engineering computation by M.K. Jain , S.R.K. Iyenger , R.K. Jain south Edition (2003) , New Age .

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER

CORE ELECTIVE PAPER IV(A): PROGRAMMING IN C

CREDIT: 5
MAX MARKS: 25
MIN MARKS: 09

COURSE OBJECTIVE:

The **course** is designed to provide complete knowledge of **C** language. Students will be able to develop logics which will help them to create programs, applications in **C**.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1 Provide exposure to problem-solving through programming.

CLO2 Understand the fundamentals of C programming.

CLO3 Train the student to the basic concepts viz. conditional and decision making, file handling of the C-programming language.

CLO4 Understand the array and multi-dimensional arrays

CLO5 Find Common Programming Error, Program testing and debugging.

UNIT-I

Introduction to C language- History of C Language. Feature of C Language, Character Set in C, Keywords , Constants, Variables in C Type declaration, Types of Output Function and Input Function , Basic Data types. Structure of C Program. A Simple C Program, Compiling a C Program,

UNIT –II

Operators: Arithmetic operators, Unary operators, Relational and logical operators, Increment and Decrement Operator, Conditional Operator, Bit-wise Operator, Assignment Operators, Precedence & Associativity Expressions.

UNIT –III

Control Statements: Conditional Expressions if statement, if else statement switch and case statement , while loop, do while loop, break, continue and goto statement. Writing programs using conditional expression.

UNIT –IV

Scope of Variable: local and global variable storage classes of C variable. Arrays (single dimension & multidimensional array)

Functions: Introduction to Function, Library Function, User defined Function: Declaration and prototype, Function Definition, Concept of Function parameters and how they are passed, Recursion Function Writing Program Using Recursive and non recursive Functions.

UNIT –V

Pointers: Declaration, Pointer Arithmetic, Structures, arrays of structures, Concept of Union, Differences between structure and Union .

Text Books:- 1 Programming in C- E Balaguruswamy
2 Programming in C- Yashwant Kanetkar.

Nandini

SJain

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St. Aloysius' College (Autonomous), Jabalpur
M.Sc III Semester (Maths)
Programming In C (Program List) Practical

Max Marks: 15
Min Marks: 06

1. Write a program in C for swapping two numbers without using third variable.
2. Write a program in C to find the greatest among three number entered by user.
3. Write a program in C to check the entered integer is even or odd.
4. Write a program in C to check the entered alphabet is vowel or consonant.
5. Write a program in C to print days using switch case.
6. Write a program in C to find factorial of entered number.
7. Write a program in C to print the Fibonacci Series.
8. Write a program in C to check the entered integer is prime or not.
9. Write a program in C for addition of two matrices.
10. Write a program in C for multiplication of two matrices.
11. Write a program in C to print table of entered number.
12. Write a program in C to convert temperature from Fahrenheit to degree Celsius.
13. Write a program in C to check entered number is palindrome or not.
14. Write a program in C to convert decimal number to binary number.
15. Write a program in C to convert binary number to decimal number.
16. Write a program in C to sort elements using bubble sort method
17. Write a program in C to sort elements using selection sort method.
18. Write a program in C to search particular element in array.
19. Write a program in C to find the value of any number using pointer.
20. Write a program in C for finding biggest and smallest number in array, and find sum of the elements.
21. Write a program in C to find value of trigonometric function correct upto 4 decimal places.
22. Write a program in C to enter data in file.

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DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
CORE ELECTIVE PAPER IV(B) : FUNCTIONAL ANALYSIS - II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

This course will cover the properties of Hilbert space including orthogonal complements, orthonormal set together with related identities and inequalities. Also the important notion of linear operator on a Hilbert space including adjoint operators, self adjoint operators and unitary operators will be dealt.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1 Have a knowledge of Hilbert space and its properties.
CLO2 Understand the concept of orthogonal complements, orthonormal set.
CLO3 Have a knowledge of Theory of linear operators, adjoint operators, self adjoint operators and unitary operators.
CLO4 Comprehend important theorems like the uniform boundedness theorem, open mapping theorem, closed graph theorem and Riesz representation theorem.
CLO5 Understand the concept of Projection, Normal and Unitary operators.

Unit-I: Uniform boundedness theorem and some of its consequences, open mapping and closed graph theorem, Hanh-Banach theorem for real linear spaces.
Unit-II: Hanh-Banch theorem for complex linear spaces and normaed linear spaces, Eeflixive spaces, Hilbert spaces, Orthonormal sets, Bessel's inequality.
Unit-III:. Complete orthonormal sets and Parseval's identity, Projection Mapping, Projection theorem.

Unit-IV: Structure of Hilbert spaces, Riesz representation theorem, Adjoint of an operator on a Hilbert space, Reflexivity of Hilbert spaces.

Unit-V: Self -Adjoint operators, Positive Operators, Projection, Normal and Unitary operators.

Text Book:

1. G. F. Simmons, Topology and Modern Analysis , McGraw Hill International Edition, 1963.
2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.

Reference Books:

1. R. E. Edward, Functional Analysis, Dover Publication, New York, 1995.
2. P. K. Jain, O. P. Ahuja and Khalil Ahmed, Functional Analysis, New Age International (P) Ltd. Publ.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER

OPEN ELECTIVE PAPER V(A) ADVANCED DISCRETE MATHEMATICS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course aspires to make students understand, analyze and evaluate algebraic structures, lattices. Boolean algebra, graphs and trees

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO 1 Understand and analyze the basic principles and results of algebraic structures, semi groups, monoids and their properties.

CLO 2 Understand and reframe concept of different kinds of lattices

CLO 3 Understand and implement concepts of Boolean Algebra

CLO 4 Comprehend and apply different types of graphs and circuit in real life problems

CLO 5 Demonstrate different traversal methods for trees and graphs

Unit-I: Algebraic systems, semigroup, monoid, subsemigroup and submonoid definition and examples, direct product of semigroup, homomorphism and isomorphism of semi group, homomorphism and isomorphism of monoid.

Unit-II: Partial order relation, total order relation, partially ordered set- poset, chain, antichain, definition and examples, Hasse diagram, dual of a poset, homomorphism and isomorphism of a poset. Lattices as posets, lattices as algebraic systems, complete lattice, complemented lattice, bounded lattice, distributive lattice, dual of a lattice, sub lattices, definition, examples and general properties of a lattices, direct product of lattices, homomorphism and isomorphism of lattices.

Unit-III: Boolean lattice, Boolean algebra, definition, examples and general properties, principle of duality, sub Boolean algebra, direct product of Boolean algebra, homomorphism and isomorphism of Boolean algebra.

Unit-IV: Edges, incidence and adjacency of edges, vertex, degree of a vertex, even, odd, isolated and pendant vertex, simple graph, multi graph, regular graph, null graph, finite graph, infinite graph, digraph, planar graph, non planar graph, complete graph, bipartite graph, definition and general properties, hand shaking lemma, isomorphic graphs, homeomorphic graphs, subgraph, vertex disjoint subgraph, edge disjoint subgraph, walk, path and circuit, labeled graph, weighted graph, shortest path in weighted graph, Dijkstra's algorithm, matrix representation of graphs and digraphs.

Unit-V: Connected graph, disconnected graph, components, minimally connected graph, definition and general properties. Tree, pendant vertex in a tree, internal vertex in a tree, distance and centers in a tree, radius of a tree, diameter of a tree, path length of a tree, rooted tree, binary tree, strictly binary tree, levels and height of a binary tree, definition and examples. Applications: Konigsberg bridge problem, utilities problem, Chinese postman problem and determining the longest monotonically increasing subsequence,

Text Books:

1. H. K. Pathak and J. P. Chauhan; Advanced Discrete Mathematics, Shiksha Sahitya Prakashan.
2. J. P. Tremblay & R. Manohar; Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

Reference Books:

1. C. L. Liu; Elements of Discrete Mathematics, McGraw-Hill Book Co.

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DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
THIRD SEMESTER
OPEN ELECTIVE PAPER V(B) MATHEMATICAL STATISTICS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Recognize the importance and value of mathematical and statistical thinking, training, and approach to problem solving, on a diverse variety of discipline and be familiar with a variety of examples where mathematics or statistics helps accurately explain abstract or physical phenomena.

COURSE OUTCOME:

Upon successful completion of this course, the student will be able to:

CLO1 Properties of statistical models,

CLO2 Knowledge of Probability theory including conditional probability. Distribution such as Bionomial, Poisson etc.

CLO3 Understand and apply the concepts of t and F Distributions and other distribution functions.

CLO4 Construct tests and estimators, and derive their properties

CLO5 Know about important theorems like Rao –Blackwell theorem-The Rao Cramer's inequality

UNIT –I: The probability set function –Random variables –The probability density function – The distribution function-Mathematical expectations-Some special mathematical expectations – Chebyshev inequality.

UNIT – II Conditional probability –Marginal and conditional distributions-The Correlation coefficient-Stochastic Independence. The Binomial, Poisson, Gamma, chi-square normal distribution.

UNIT – III: Distributions of functions of Random variables –Sampling theory-Transformation of Variables of Discrete type-Transformation of Variables of the continues type.

UNIT – IV: The t and F Distributions – Distribution of order statistics –The moment –generating function Technique-The Distribution of X and.Limiting distribution –Stochastic convergence-Limiting moment generating function-The central limit theorem –Some theorems on Limiting Distribution.

UNIT-V: Point estimation-Measures of quality of estimations-confidence intervals for meansconfidence intervals for difference of Means-confidence intervals for variances. A Sufficient statistics for a parameters- The Rao –Blackwell theorem-The Rao Cramer's inequality.

Text Book: Introduction to Mathematical Statistics by Robert V. Hogg Allen T. Craig, Macmillan publishing co., Inc., New York -1978,

References : 1. Mathematical Statistics by J.N. Kapur, H.C. Saxena- S. Chand Publications 2.Introduction to Mathematical Statistics Robert V Hogg, Allencraig, Joseph W Mekean , Pearson Publishers

M. Sc. (MATHEMATICS)
FOURTH SEMESTER
CORE PAPER I: OPERATION RESEARCH-II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course aspires to make students comprehend, formulate, analyze and determine optimal solution to real life problems.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO 1 Formulate, solve and apply assignment problems so that cost is minimized.

CLO 2 Frame and evaluate job sequencing problems

CLO 3 Deduce the practicality of game theory and implement the techniques in real life perspective.

CLO 4 Develop a working knowledge of concepts and methods related to designing of networks, CPM-PERT, design, manage and complete projects in optimal time.

CLO 5 Understand the concepts of various inventory models, EOQ, multi items deterministic model and evaluate the cost involved therein. Control resource allocation and manage inventory.

Unit-I: Mathematical formulation of assignment problem, assignment algorithm, solution of assignment problem by Hungarian method, rules to draw minimum number of lines, unbalanced assignment problem, maximal assignment problem, traveling salesman problem.

Unit-II: Sequencing problem, Johnson's algorithm, idle time, elapsed time, processing n jobs on two machines, n jobs on three machines, n jobs on m machines, processing two jobs through m machines.

Unit-III: Two person zero-sum game, maximin-minimax principle, games with/without saddle points, graphical solution of (2 x m) and (m x 2) games, principal of dominance, value of the game, optimal strategies.

Unit-IV: Introduction, historical development and applications of CPM and PERT, concepts, network diagram representation, Fulkerson's rule, backward pass computation, forward pass computation ,total float, free float, independent float, network construction, CPM and PERT calculations, Project management by CPM and PERT.

Unit V: Inventory theory, types of inventory models, cost involved in inventory problems, variables in inventory problems, average inventory, concept of EOQ, economic lot size system with uniform and non-uniform demand, economic lot size with finite rate of replacement, production lot size model, multi items deterministic models with one constraint, limitation on investment, floor space and inventory.

TEXT BOOKS:

1. S. D. Sharma; Operations Research.

REFERENCE BOOKS:

1. K. Swarup; P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.
2. H. A. Taha; Operations Research- An introduction, Macmillan Publishing Co. Inc. New York.
3. P. K. Gupta and D. S. Hira; Operations Research, an Introduction, S. Chand & Company Ltd. New Delhi.

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
FOURTH SEMESTER
CORE PAPER II : NUMERICAL METHODS II

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The students will learn extrapolation methods and the mathematical theory of finite element methods.

COURSE LEARNING OUTCOMES:

Upon completion of the course, Students will be able to

CLO 1 Understand extrapolation methods, Richardson's extrapolation and ordinary differential equations.

CLO 2 Knowledge of multi step methods, explicit multistep methods and implicit multistep method.

CLO 3 Solve boundary value problem with different conditions, linear second order differential equations by different methods.

CLO 4 Understand Finite difference methods and Linear Second Order Differential Equation.

CLO 5 Understand finite element methods and linear Lagrange polynomial.

Unit 1 Extrapolation methods, Richardson's Extrapolation, Ordinary differential equations, Reduction of Higher order Equations to the system of first order Differential Equations, system of Linear first order Differential Equations with Constant Coefficients, Difference Equations.

Unit 2 Multi step methods, Explicit Multistep Methods, Adams-Bashforth Methods (i=0), Nystrom Methods (i=1), Implicit Multistep Methods, Adams-Moulton Method (i=0), Milne-Simpson Method (i=1), Predicator and corrector methods, P$(EC)^m E$ Method, P$M_p C M_c$ Method, Stability analysis of multistep methods.

Unit 3 Ordinary Differential Equations: Boundary value problems, Initial Value Problem Method (Shooting method), Boundary conditions of the first kind, Boundary conditions of the second kind, Boundary conditions of the third kind.

Unit 4 Finite difference methods, Linear Second Order Differential Equation, Derivative Boundary Conditions, Fourth Order Method when u' is absent, Nonlinear Second Order Differential Equation u''=f(x,u), Newton-Raphson Method, Nonlinear Second Order Differential Equation u''=f(x,u,u').

Unit 5 Finite element method, Solution of the Variation Problem, Ritz Method, Finite Elements, Linear Lagrange Polynomial, Ritz Finite element method, Finite element Solution of Linear Boundary value problems, Assembly of element Equations, Mixed Boundary Conditions .

Text Book

Numerical Method for scientific and Engineering computation by M.K. Jain, S.R. K. Iyenger, R. K. Jain south Edition(2003), New Age.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
FOURTH SEMESTER
CORE ELECTIVE PAPER – III(A) : DIVERGENT SERIES

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course aim to provide students with a firm grounding in the theory and techniques of divergent series. Also comprehend the Important theorems like the Consistency theorem for Cesaro Summability, Limitation Theorem etc.

COURSE LEARNING OUTCOMES:

Upon completion of the course, Students will be able to

CLO1 Understand order relations, asymptotic relation, the method of arithmetic, Holder and Abel means.

CLO2 Find cubic spline interpolation, bivariate interpolation and Lagrange bivariate interpolation.

CLO3 Understand the concept of Able's transformation, Cesaro mean, change of order of summation, relation between Cesaro and Able's Summability.

CLO4 Understand Abelian methods of summability, regularity of Abelian means, inclusion theorem,

CLO5 Understand the concept of Euler mean, limitation theorem and regularity theorem.

Unit-1: Definitions and Examples of Order Relations (big 0, little 0), Asymptotic Relation, The method of Arithmetic means, Holder means, Abel means, The Transformation matrix and regularity theorem for each mean.

Unit-2: Abel's Transformation and its applications, Cesaro means, Definition and examples, Identities relating Cesaro sums, change of order of summation, Relation between Cesaro and Abel's Summability: Theorems 55, 56, and 57.

Unit-3: Consistency theorem for Cesaro Summability, Regularity Theorems for Cesaro's method, Cesaro means of both integral and non-integral orders.

Unit-4: Limitation Theorems, Tauberian conditions and Tauberian Theorems, Littlewood's extension of Tauber's first Theorem.

Unit-5: Abelian method (A, λ) of summability, Regularity of Abelian means, Inclusion theorem, Euler mean, Regularity theorem.

Text Books:

1. G.H. Hardy, Divergent Series, Oxford, University Press, 1948.

Reference Books:

1. A. Dold and B. Eckmann (eds.) Absolute Summability of Fourier Series, Lecture Notes in Math. Springer-Verlag, 1984.

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
FOURTH SEMESTER
CORE ELECTIVE PAPER III(B): PROGRAMMING IN C++

CREDIT: 5
MAX MARKS: 25
MIN MARKS: 09

COURSE OBJECTIVE:

The **course** is designed to provide complete knowledge of C++ language. Students will be able to develop logics which will help them to create programs, applications in C++.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1. Comprehend the use of object-oriented concepts to implement object oriented programs in C++ with applications to encapsulation, inheritance and polymorphism.
CLO2. Develop knowledge of basic data structures for storage and retrieval of ordered or unordered data.
CLO3. Realize the applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching,
CLO4. Understand sorting of each data structure.
CLO5. Understand data base design normalization upto BCNF, distributive system– clouds.

Unit 1: object oriented programming, class and scope, nested classes, pointer class member class initialization, assignment and distribution.

Unit 2: over load function and operators templates including class templates, class inheritance and subtyping, multiple and inheritance.

Unit 3: data structure analysis of algorithm q, W, O, o, w notations, lists , stacks, and Queues, sequential and linked representation, tree, binary tree – search tree implementation, B – tree (concept only)

Unit 4: Hashing – open and closed, sorting :sort, shell sort , heap sort and their analysis.

data base system –role of data base system, data base system architecture.

Unit 5: Introduction to relational algebra and relational calculus. SQL-O basis features Including views, integrity constrains, data base design normalization upto BCNF, distributive system– clouds.

Reference books:

1 **B**, stroustrup, the C++ programming language, Addison – Wesley.
2 **C**.I date, introduction to data base system, Addison- Wesley.

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ST. ALOYSIUS COLLEGE (AUTO.), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-2023
M.Sc.(MATHEMATICS)
FOURTH SEMESTER
PRACTICAL – PROGRAMMING IN C++

MAX: 15
MIN: 6

1. Write a program in C++ language to define nested class.
2. write a program in C++ to implement multiple inheritance.
3. write a program in C++ for operator overloading.
4. write a program in C++ using function overloading to calculate area of circle, square and rectangle.
5. Write a program showing implementation of stack class having the functionality of push ,pop operations.
6. Write a program to implement a queue class with required operations/ functions.
7. Write a program to implementing linked list as a class. Also perform some required operations like inserting, deleting nodes.
8. Write a program in C++ Convert time from seconds to HH:MM:SS format using class.
9. Write a program in C++ to implement the Heap sort algorithm.
10. Write a program in C++ language for use of sort, shell sort, quick-sort.

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. SC. (MATHEMATICS) FORTH SEMESTER

CORE ELECTIVE PAPER IV(A)- INTEGRATION THEORY

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Recognize the importance and value of Measure spaces, Measurable functions, Integration, Convergence theorems and be familiar with a variety of measure and measurability.

COURSE LEARNING OUTCOMES:

On successful completion of this course students will be able to:

CLO1. Understand the basic principles of signed measures, The Radon- Nikodym theorem, Lebesgue decomposition.
CLO2. Comprehend the basic principles of outer measure and measurability, extension theorem,
CLO3. Understand Lebesgue-Steiltjes integral, product measures, Fubini's theorem.
CLO4. Appreciate the basic principles of Baire sets, Baire measure, continuous functions with compact support,
CLO5. Understand regularity of measures on locally compact spaces, integration of continuous functions with compact support, Riesz- Markoff theorem.

Unit I: Measure spaces, Measurable functions, Integration, Convergence theorems.

Unit II: Signed measures, The Radon-Nikodym theorem, Lebesgue decomposition, LP spaces, Riesz representation theorem.

Unit III: Outer measure and measurability, The extension theorem, Lebesgue-Steiltjes integral, Product measures, Fubini's theorem.

Unit IV: Baire sets, Baire Measure, Continuous functions with compact support, Regularity of measures on locally compact spaces.

Unit V: Integration of continuous functions with compact support, Riesz- Markoff theorem.

Recommanded Books :

1. H.L. Royden, Real Analysis, Mc millan Pub. Co. Inc. New York, 4th Edition, 1993.
2. G.de.Barra., Measure Theory and Integration, Wiley Eastern Limited, 1981
3. Inder K. Rana. An introduction to Measure & Integration Narosa Pub. House, Delhi,1997.
4. P.K. Jain, N.P. Gupta, Lebesgure Measure and Interation New Age International (P) Ltd., New Delhi, 1986.

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ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
FOURTH SEMESTER

CORE ELECTIVE PAPER IV(B): FUZZY SETS AND THEIR

APPLICATIONS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

Provide an understanding of **the** basic mathematical elements of **the** theory of **fuzzy sets**. Provide an emphasis on **the** differences and similarities between **fuzzy sets** and classical **sets** theories.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1. Understand the difference between crisp sets and fuzzy sets, Fuzzy membership function, types and operations of fuzzy sets and their properties.
CLO2. Fuzzy numbers and fuzzy arithmetic.
CLO3. Basic concepts of fuzzy relations, fuzzy graphs and fuzzy logic.
CLO4. Knowledge of m fuzzy sets and intuitionistic fuzzy sets
CLO5. Understand Fuzzy relations, Crisp v/s Fuzzy relations.

Unit-I: Support height nucleus of a fuzzy set, cardinality of a fuzzy set containment of two fuzzy sets, degree of subsethood, Fuzzy set, Membership function, Basic definition and concepts, Types of Fuzzy sets- normal subnormal fuzzy set, normalization α-cut set, strong α-cut, convex fuzzy set, necessary and sufficient condition for convexity of a fuzzy set,

Unit II: Operations on fuzzy sets, Union, Intersection, Complement of a fuzzy set, Decomposition of fuzzy sets, Cartesian Product, Algebraic product, Product of a fuzzy set with a crisp number, contract intensification and fuzzification Bounded sum and difference, t-norms, t-conorms, Power of a fuzzy set, Disjunctive sum of two fuzzy sets, examples.

Unit-III: Properties of fuzzy sets- commutative, associative, distributive, idempotent, identity, involution, De-Morgan's laws, and their proofs, equality of two fuzzy sets, examples.

Unit-IV: The Zadeh Extension Principle, Fuzzy numbers, Fuzzy arithmetic

Unit V: Fuzzy relations, Crisp v/s Fuzzy relations, Composite Fuzzy relation, Binary Fuzzy relations, Fuzzy equivalence relation, Fuzzy compatibility relation, Fuzzy relation equation, Similarity relations Fuzzy graphs.

Fuzzy logic- classical logic, multivalued logic, Fuzzy prepositions, Fuzzy quantifiers, Linguistic variables and Hedges, Inference from conditional Fuzzy preposition

Text Book-

1. G.J. Klir and Yuan, Fuzzy sets and Fuzzy Logic: The compositional rule of inference, Prentice Hall of India, New Delhi, 1995.
2. H.J. Zimmermann, Fuzzy set Theory and its Applications, Allied publishers Ltd, New Delhi 1991.

Reference Books:

1. Pundir and Pundir ,Fuzzy Sets and their Applications , Pragati Prakashan, Meerut, 2012
2. Timothy J.Ross, Fuzzy Logic with Engineering Applications, John Wiley & Sons, 2010

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FOURTH SEMESTER
OPEN ELECTIVE PAPER V(A) MATHEMATICAL MODELING

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

The course aspires to make students understand and formulate mathematical models in real life situations

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO 1 Understand the concepts and techniques of mathematical modeling and its applications in real life situations.
CLO 2 Frame simple mathematical models with the help of differential equations and its application to evaluate linear growth and decay models.
CLO 3 Develop mathematical model through difference equations in finance, population dynamics and genetics.
CLO 4 Implement techniques and model situations through graphs.
CLO 5 Establish mathematical models via linear programming in forest management, transportation and assignment.

Unit I Simple situations requiring mathematical modeling, techniques of mathematical modeling, Classifications, Characteristics and limitations of mathematical models, Some simple illustrations.
Unit II Mathematical modeling through differential equations, linear growth and decay models, non-linear growth and decay models, Compartment models, Mathematical modeling in dynamics through ordinary differential equations of first order.

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Unit III Mathematical models through difference equations, some simple models, and Basic theory of linear difference equations with constant coefficients, Mathematical modeling through difference equations in economic and finance, Mathematical modeling through difference equations in population dynamic and genetics.

Unit IV Situations that can be modeled through graphs. Mathematical models in terms of Directed graphs, Mathematical models in terms of signed graphs, Mathematical models in terms of weighted digraphs.

Unit V Mathematical modeling through linear programming, Linear programming models in forest management. Transportation and assignment models.

Reference Books:

1. J. N. Kapur: Mathematical Modeling, Wiley Eastern.
2. D. N. Burghes: Mathematical Modeling in the Social Management and Life Science, Ellie Herwood and John Wiley.
3. F. Charlton; Ordinary Differential and Difference Equations, Van Nostrand.

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M. Sc. (MATHEMATICS)
FOURTH SEMESTER
OPEN ELECTIVE PAPER V (B) : WAVELETS

CREDIT: 5
MAX MARKS: 40
MIN MARKS: 14

COURSE OBJECTIVE:

To expose the students to the basics of **wavelet** theory and to illustrate the use of **wavelet** processing.

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

CLO1. Understand Fourier analysis
CLO2. Comprehend wavelets, orthogonal wavelets, wavelet series, linear phase filtering
CLO3. Identify orthogonal two-scale symbols.
CLO4. Understand the concept of Linear phase filtering, Compactly supported wavelets.
CLO5. Construction of Compactly supported orthogonal wavelets.

Unit I. Fourier Analysis: Fourier and inverse Fourier transforms, Convolution and delta function, Fourier transform of Square integrable functions. Fourier series, Basic Convergence Theory and Poisson's Summation formula.

Unit II. Wavelet Transforms and Time Frequency Analysis: The Gabor Transform. Short-time Fourier transforms and the uncertainity principle. The integral wavelet transforms Dyadic wavelets and inversions. Frames.

Unit III. Wavelet Series. Scaling Functions and Wavelets: Multi resolution analysis, scaling functions with finite two scale relations. Direct sum decomposition of L2 (R) .

Unit IV. Linear phase filtering, Compactly supported wavelets, Wavelets and their duals, Orthogonal Wavelets and Wavelet packets, Example of orthogonal Wavelets.

Unit V. Identification of orthogonal two-scale symbols, Construction of Compactly supported orthogonal wavelets, Orthogonal wavelet packets, orthogonal decomposition of wavelet series.

References:

1. C.K.Chui, A First Course in Wavelets, Academic press NY 1996.
2. I. Daubechies, Ten Lectures in Wavelets, Society for Industrial and Applied Maths, 1992.