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.

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 special functions.

CLO 2 Understand purpose and functions of the gamma and beta functions

CLO 3 Use power series methods to solve differential equations.

CLO 4 Perform operations Bessel differential equations along with the corresponding recurrence formulas of different functions.

CLO 5 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 Hypergoemetric 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.

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
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 Chebeschev Polynomials 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, Cubic spline interpolation, Natural Spline.

UNIT – II :

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-1: An overview of programming languages , Programmes development, functions Variables and Constants Expressions. Formatting sources files continuation character, the Processors.

Unit-2: Scaler data type-Declarations, different types of integers. Different kinds of Integer Constants Floating-point type Initialization, Mixing types, Explicit conversions-casts. Enumeration types. The void data type ,Type defs.

Unit-3: Control flow-Conditional Branching, the switch statement. Looping. Nested Loops, the Break and Continue Statement. The Goto Statement Infinite Loops. Operators and Expressions-Precidence and Associatively. Unary plus and Minus operator. Binary, Arithmetic operator, arithmetic assignment operators. Increment and Decrement operator. Comma Operator, Relational Operators, Logical Operators bit-manipulation operators Bitwise assignment operators, size of operators, Conditional operators.

Unit-4: Array and multi dimentional arrays. Storage Classes-fixed vs. Automatic duration scope, global. The Register Specifier Structures and Unions, Pointers.

Unit-5: Developing a C Program: Introduction, Common Programming Error, Program testing and debugging, Program Efficiency. File management in C:Introduction, defining a file, closing a file, input/output operation On files, error handling during I/O operation.

Reference Books:

1. Samuel P.Harkison and Gly L Steels Jr.C:A reference manuel, II Edition ball 1984
2. Brain W Keringham & Dennis M Richie the C Programmed Language II edition(ANSI features) Prentice Hall 1989.

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.

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
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.

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.

ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
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 LEARNING OUTCOMES:

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

Pratibha