ST. ALOYSIUS COLLEGE (AUTO), JABALPUR
DEPARTMENT OF MATHEMATICS 2022-23
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

Pratibha Archana Nandini Sjaid Au

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, PM_pCM_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.

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.

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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.

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.

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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DEPARTMENT OF MATHEMATICS 2022-23
M. Sc. (MATHEMATICS)
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.