

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

(Established under section 3 of UGC Act, 1956)

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600119.



MSC MATHEMATICS SYLLABUS

**SCHOOL OF SCIENCE AND HUMANITIES
DEPARTMENT OF MATHEMATICS**

SCSA5109	OBJECT ORIENTED PROGRAMMING	L	T	P	CREDIT
		3	0	0	3

UNIT I INTRODUCTION TO OBJECT ORIENTED PROGRAMMING**9 hrs.**

Object Oriented Programming Paradigms - Comparison of Programming Paradigms – Object Oriented Languages - Benefits of Object Oriented Programming - Comparison with C - Overview of C++ -Pointers- Functions - Scope and Namespaces - Source Files and Programs.

UNIT II CLASSES AND OBJECTS**9 hrs.**

Working with classes – Classes and objects – Class specification-Class objects-Accessing class members-Defining class members-Inline functions-Accessing member functions within class-Data hiding-Class member accessibility - Empty classes,

UNIT III CONSTRUCTORS AND OVERLOADING**9 hrs.**

Default constructors - Parameterized constructors - Constructor overloading-Copy constructors - new, delete operators-"this" pointer-friend classes and friend functions -Function overloading- Unary Operator overloading -Binary Operator overloading.

UNIT IV INHERITANCE**9 hrs.**

Base class and derived class relationship-Derived class declaration-Forms of inheritance-Inheritance and member accessibility-Constructors in derived class-Destructors in derived class-Multiple inheritance-Multi level inheritance-Hybrid inheritance-Virtual base classes-Member function overriding-Virtual functions-Abstract classes-Pure Virtual functions.

UNIT V I/O AND LIBRARY ORGANIZATION**9 hrs.**

I/O Stream - File I/O - Exception Handling - Templates - STL – Library Organization and Containers – Standard Containers - Overview of Standard Algorithms - Iterators and Allocators.

Max Hrs: 45 hrs.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Demonstrate object-oriented problem-solving and programming principles
CO2	Outline the C++ programming language's most important features and aspects
CO3	Use concepts such as class, method, constructor, instance, data abstraction, function abstraction, inheritance, overriding, overloading, and polymorphism to solve problems.
CO4	In complex programming situations, use virtual and pure virtual functions
CO5	Using the techniques covered in the course, analyze, write, debug, and test basic C++ programs
CO6	Able to address a variety of problems using various object-oriented concept

REFERENCE BOOKS:

1. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill, 4th Edition, 2010
2. Venu Gopal.K.R, Ravishankar.T, and Raj kumar, "Mastering C++", Tata McGraw Hill, 1999.
3. Bjarne Stroustrup, "The C++ programming language", Addison Wesley, 3rd Edition, 1998.
4. John R Hubbard, "Programming with C++", Schaums Outline Series, McGraw Hill, 2nd edition, 2009.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks:70

PART A:10 questions of 2 marks each – No choice

PART B:2 questions from each unit of internal choice, each carrying 10 marks

Exam Duration: 3 hrs.

20 marks

50 marks

SCSA6103	OBJECT ORIENTED PROGRAMMING LAB	L	T	P	CREDIT
		0	0	4	2

Objective:

- To understand the fundamental concepts of object oriented programming.
- Be familiar with concepts like abstraction, inheritance, polymorphism.
- To understand the concept of Classes.

List of Experiments

1. Develop a C++ program to implement a class, object creation, member function invocation concept.
2. Develop a C++ program to implement the various constructors and destructor concept.
3. Develop a C++ program to implement a friend function, Inline function.
4. Develop a C++ program to implement an operator (Unary & Binary) overloading concept.
5. Develop a C++ program to implement a function overloading concept.
6. Develop a C++ program to implement a run time polymorphism.
7. Develop a C++ program to implement the following inheritance types.
 - a. Single
 - b. Multiple
 - c. Multilevel
 - d. Hierarchical
 - e. Hybrid
8. Develop a C++ program to implement an Abstract class concept.
9. Develop a C++ program to implement a Virtual function.
10. Develop a C++ program to find the number of characters in a file.
11. Develop a C++ program to handle the exceptions.

Case Study

1. Categorization of living beings as humans, animals, birds, insects, etc., using inheritance.
2. Develop user defined manipulator for the following named

Rupees for displaying Rs. and sets the precision to 2.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Develop and object-oriented paradigm with concepts of streams, classes, functions, data and objects
CO2	Develop a Program to initialize and destroy objects using Constructor, destructor function
CO3	Build a program using the concept of function overloading and operator overloading

CO4	Implement Inheritance concept in real time applications
CO5	Construct a program using Abstract Class and Virtual function
CO6	Create an application using C++ for implementing File and Exceptional Handling

SMTA5203	NUMBER THEORY AND LINEAR ALGEBRA	L	T	P	CREDIT
		3	0	0	3

UNIT 1**9 Hrs**

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation $ax + by = c$. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.

UNIT 2**9 Hrs**

Fermat's little theorem and pseudo primes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.

UNIT 3**9 Hrs**

Rank of a matrix – Elementary transformation, reduction to normal form, row reduced echelon form. Computing the inverse of a non singular matrix using elementary row transformation.

UNIT 4**9 Hrs**

System of linear homogeneous equations. Null space and nullity of matrix. Sylvester's law of nullity. Range of a matrix. Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix.

UNIT 5**9 Hrs**

Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix Cayley - Hamilton theorem.

Max Hrs: 45 Hrs**REFERENCE BOOKS**

1. David M. Burton, Elementary Number Theory, Sixth Edn., TMH.
2. Shanti Narayanan & Mittal, A Text Book of Matrices, Revised edn., S. Chand.
3. C.Y. Hsiung, Elementary Theory of Numbers. Allied Publishers.
4. Neville Robbins, Beginning Number Theory, Second Ed. Narosa.
5. George E. Andrews, Number Theory, HPC.
6. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Learn divisibility property of integers. Distribution of prime numbers. Fundamental theorem of arithmetic. Properties of congruence. Chinese remainder theorem. Application to solve simple problems..
CO2	Prove Fermat's little theorem, Wilson's theorem and their application to simple problems.
CO3	Introduction to number theoretic function and their properties.
CO4	Elementary transformation and their application in solving problems.
CO5	Matrix representation of homogeneous and non-homogeneous equations. Rank, nullity and range of the matrix.
CO6	Characteristic equation and roots of a complex matrix. Cayley Hamilton theorem.

UNIVERSITY EXAM QUESTION PAPER PATTERN**Max. Marks:70****PART A:** 10 questions of 2 marks each – No choice**PART B:** 2 questions from each unit of internal choice, each carrying 10 marks**Exam Duration: 3 hrs.**

20 marks

50 marks

SMTA5204	ADVANCED DATA ANALYTICS	L	T	P	CREDIT
		3	0	0	3

UNIT I Introduction to R**9 Hrs**

Introduction: Introduction to R – Downloading and Installing R – Getting Data into R: First Step in R: Typing in Small Datasets – Concatenating Data with c Function – Combining Variables with the c, cbind, rbind Functions - Vector Function –Matrix - data frame – List - Importing Excel Data – Accessing Data from other Statistical Packages – Accessing the Database. Functions - The Attach Function – Exporting Data - The Tapply Function – The Supply and Lapply Function – The Summary and Table Function.

UNIT II Data standardizing**9 Hrs**

Data standardizing – Z Score – Negative Z Score – Continuous Distributions - Compute proportions – Relative Frequency histogram - Normalized Distribution using Z table.

UNIT III Probability Distribution**9 Hrs**

Probability Distributions - Probability of mean – location of mean distribution - Sampling Distributions — Klout Sampling Distribution – Understanding Shape of Distribution – Standard Error - Standard Deviation of sampling distribution – Ratio of Sampling Distribution - Central Limit Theorem R – Mean of sample means Advanced Analytics Regression Analysis – Simple Regression Analysis – Logistic Regression.

UNIT IV Introduction to time series**9 Hrs**

Introduction to time series data - application of time series from various fields -Modelling time series as deterministic function plus IID errors - Components of a time series (trend, cyclical and seasonal patterns, random error) Decomposition of time series - Estimation of trend: free hand curve method, method of moving averages, fitting various mathematical curves and growth curves.

UNIT V Analysis of time-series**9 Hrs**

Analysis of time-series: Different components of a time series. Determination of trend by free hand smoothing. Method of moving average and by fitting of a mathematical curve. Determination of seasonal indices by method of trend ratios and ratios to moving averages.

Max Hrs: 45 Hrs**REFERENCE BOOKS**

1. Chatfield C. (1980): The Analysis of Time Series – An Introduction, Chapman & Hall.
2. Brockwell and Davis (2010): Introduction to Time Series and Forecasting (Springer Texts in Statistics), 2nd Edition
3. Johnson, R.A. And Wichern, D.W. (2007): Applied Multivariate Analysis, 6th Edn., Pearson & Prentice Hall
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I, 8th Edn. The World Press, Kolkata.
5. Hadley Wickham, ggplot2: Elegant graphics for data analysis, Springer (2009)
<http://www.springerlink.com.proxy.lib.umich.edu/content/978-0-387-98140-6/contents/>
6. Phil Spector, Data Manipulation with R, Springer ,
(2008)<http://www.springer.com/statistics/computational+statistics/book/978-0-387-74730-9>
7. Leland Wilkinson, The Grammar of Graphics, Springer
(2005),<http://www.springerlink.com.proxy.lib.umich.edu/content/978-0-387-24544-7/contents/>

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Identify the command for exporting data and accessing data from other statistical packages using R software
CO2	Understand normalized distribution using Z table and standard error.
CO3	Apply the method of moving average in time series.
CO4	Analyze the components of time series and determination of trend.
CO5	Evaluate the proportion in data standardizing
CO6	Organize the data to fit a mathematical curve using time series.

UNIVERSITY EXAM QUESTION PAPER PATTERN**Max. Marks : 70****Exam Duration : 3 Hrs****PART A :** 4 questions of 5 marks each – No choice -

20 marks

PART B : 5 questions from each unit of internal choice, each carrying 10 marks -

50 marks

SMTA6201	R FOR DATA ANALYTICS – LAB	L	T	P	CREDITS
		0	0	4	2

LIST OF EXPERIMENTS

1. **Basic fundamentals**, installation and use of software
2. Data editing, use of R as a calculator
3. **Functions and matrix operations, missing data and logical operators**
4. Conditional executions and loops, data management with sequences.
5. Data management with repeats, sorting, ordering and lists.
6. Vector indexing, factors, Data management with strings, display and formatting.
7. Data management with display paste, split, find and replacement, manipulation with alphabets, evaluation of strings, data frames.
8. Handling of bivariate data through graphics, correlations, programming and illustration with examples.
9. **Computation of Probabilities** (Binomial, Poisson and Normal). Simple Correlation and Simple Regression.
10. **Test of Significance** (t test, F test, Z test and Chi square test). One way ANOVA and Two way ANOVA.

References

1. Introduction to Statistics and Data Analysis – with exercises , Solutions and Applications in R by Christian Heumann, Michael Schomaker and Shalabh, Springer 2016.
2. The R Software-Fundamentals of Programming and Statistical Analysis – Pierre Lafaye de Micheaux, Remy Drouihet, BenoitLiquet, Springer2013.
3. A Beginner's Guide to R (Use R) by Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Able to list operations, operators and fundamentals of R
CO2	Understand the concept of Conditional executions, loops, data management with sequences, Data management with repeats, sorting, ordering and lists
CO3	Examine program with examples
CO4	Analyze binomial, poisson and normal probabilities
CO5	Evaluate one way and two way ANOVA
CO6	Create visualizations using R

SMTA5301	ADVANCED GRAPH THEORY	L	T	P	CREDIT
		3	1	0	4

UNIT 1 Graphs and Digraphs**10 Hrs**

Elementary Concepts of Graphs and Digraphs, Graphs - Degree sequences - Connected graphs and Distance - Digraphs and Multigraphs - Cut vertices - Bridges - Blocks - Automorphism group of a graph.

UNIT 2 Trees**10 Hrs**

Trees and Networks: Trees, cut edges and bonds, cut vertices, Cayley Formula, the maxflow min-cut theorem, connectivity, blocks. The Connector problem, various Menger's theorem.

UNIT 3 Euler and Hamiltonian Graphs**10 Hrs**

Euler and Hamiltonian Paths. Necessary and sufficient conditions for Euler circuits and paths in simple, undirected graphs. Hamiltonicity: noting the complexity of hamiltonicity, Traveling Salesman's Problem, Nearest neighbor method.

UNIT 4 Planarity and Connectivity**10 Hrs**

Planarity in graphs, Euler's Polyhedron formula. Kuratowski's theorem. Vertex connectivity, Edge connectivity, covering, Independence.

UNIT 5 Matchings And Coverings**10 Hrs**

Matching in Bipartite graphs, perfect matching. The personnel Assignment problems, The Optimal assignment problems. Colorings: Edge chromatic number, Coloring of Chordal graph, Class-1 graphs, Class-2 graphs, Vizing's theorem, Brook's theorem

Max Hrs: 50 Hrs**REFERENCE BOOKS**

1. Bondy, J. A. and Murty, U.,S.,R., Graph Theory with Applications, North Holland Publication (2000).
2. M.Murugan, Topics in Graph theory and Algorithms, Muthali Publishing House, Annanagar, Chennai, First Edition, 2003.
3. Narasingh Deo, Graph Theory with application to Engineering and Computer Science, Prentice Hall India, 2010.
4. S.A.Choudum, Graph Theory, Macmillan India Limited.
5. F.Harary, Graph Theory, Narosa Publishing House, 2001.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define cut vertices, Blocks, connectedness, matching, covering, and coloring in graphs
CO2	Explain the relation between independence number and covering number in a graph. Explain Euler and Hamiltonian graphs
CO3	Explain Mengers theorem on Connectedness Berge theorem on Matching. Chromatic number of Chordal graphs,
CO4	Compare Connectivity and connectedness in graphs and maximum matching and minimum matching in a graph. Hence deduce a relation between the parameters.
CO5	Evaluate Chromatic number, covering, independent number of various graphs
CO6	Create a Characterization for 2- connectedness in graphs, Matchings in Bipartite graphs.

UNIVERSITY EXAM QUESTION PAPER PATTERN**Max. Marks : 70****Exam Duration : 3 Hrs****PART A** : 4 questions of 5 marks each – No choice -

20 marks

PART B : 5 questions from each unit of internal choice, each carrying 10 marks -

50 marks

SMTA5303	FUZZY ANALYSIS	L	T	P	CREDIT
		3	0	0	3

UNIT 1 FROM CLASSICAL SETS TO FUZZY SETS**9 Hrs**

Fuzzy set: Basic types and Basic concepts –Fuzzy sets Versus Crispsets:Extension Principle for fuzzysets– Operations on Fuzzysets: Types of operations–Fuzzy complements.

UNIT 2 FUZZY ARITHMETIC**9 Hrs**

Fuzzy numbers-Linguistic variables–Arithmetic operations on intervals– Arithmetic operations on Fuzzy numbers–Lattice of Fuzzy numbers –Fuzzy equations.

UNIT 3 FUZZY LOGIC**9 Hrs**

Fuzzy Propositions–Linguistic Hedges–Inference from conditional Fuzzy propositions – Inference from conditional and qualified propositions.

UNIT 4 FUZZY DECISION MAKING**9 Hrs**

Individual decision making–Fuzzy Ranking methods–Fuzzy Linear programming.

UNIT 5 FUZZY RELATIONS**9 Hrs**

Fuzzy Relations - Binary Fuzzy Relations – Binary Relations on a Single Set- Fuzzy Equivalence Relations.

Max Hrs: 45 Hrs**REFERENCE BOOKS:**

1. George J. Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, PHI, 2004.
2. A. Nagoor Gani and V. J. Chandrasekaran, A first look at Fuzzy Graph Theory, Allied Publishers Pvt. Ltd.
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications–McGraw-Hill, Inc.,
4. H. J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, 1991.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define the fuzzy set and list the various operations on fuzzy set.
CO2	Give examples for linguistic variables
CO3	Explain arithmetic operations on intervals, fuzzy numbers with examples
CO4	Distinguish different type of fuzzy proposition with example
CO5	Evaluate fuzzy ranking method for individual decision making and group decision making.
CO6	Construct the composition of fuzzy relation and develop the properties of fuzzy relation

UNIVERSITY EXAM QUESTION PAPER PATTERN:**Max. Marks : 70****PART A :** 4 questions of 5 marks each – No choice -**PART B :** 5 questions from each unit of internal choice, each carrying 10 marks -**Exam Duration : 3 Hrs**

20 marks

50 marks

SMTA5304	ADVANCED NUMERICAL METHODS	L	T	P	CREDIT
		3	0	0	3

UNIT 1**9 Hrs**

Transcendental and Polynomial Equations: Iteration method based on Second degree equations: The Chelyshev Method – Multipoint Iteration Methods – The Bridge Vieta Method – The Baristow Method – Graeffe's root Square Method.

UNIT 2**9 Hrs**

The System of Algebraic Equations and Eigen Value Problems: Iteration Methods-Jacobi Method, Gauss Seidel Method, Successive Over Relaxation Method – Iterative Method for A-1 – Eigen Values and Eigen Vectors – Jacobi Method for symmetric Matrices, Power Method.

UNIT 3**9 Hrs**

Interpolation and Approximation – Hermite Interpolation – Piecewise cubic Interpolation and cubic Spline interpolation – Bivariate interpolation – Lagrange and Newton's Bivariate interpolation – Least Square approximation – Gram-Schmidt Orthogonalizing Process.

UNIT 4**9Hrs**

Differentiation and Integration; Numerical Differentiation – Methods Based on Interpolation – Partial Differentiation – Numerical Integration – Methods Based on Interpolation – Methods Based on Undetermined Coefficients – Gauss Quadrature methods - Gauss Legendre and Gauss Chebyshev Integration Methods – Double Integration – Trapezoidal and Simpson's Rule – Simple Problems.

UNIT 5**9 Hrs**

Ordinary Differential Equations: Numerical Methods – Euler Method – Backward Euler Method – Mid-Point Method – RungeKutta Methods – Implicit RungeKutta Methods – Predictor – Corrector Methods.

Max Hrs:45 Hrs**TEXT / REFERENCE BOOKS**

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Fourth Edition.
2. Samuel.D.ConteandCarl DeBoor,ElementaryNumericalAnalysis,ThirdEdition,1965.
3. F.B.Hildebrand,IntroductiontoNumericalAnalysis,TMH, 1979.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Recall transcendental and polynomial equations and solve it by different methods such as Chebyshev Method, Multipoint Iteration Methods, Beirge Vieta Method, Baristow Method, Graeffe's root Squaring Method to the Second degree equation
CO2	Summarize the different method for solving eigen value, eigen vector and inverse of A^{-1} for system of algebraic equations
CO3	Choose appropriate interpolation formula such as Lagrange, Newton's Bivariate interpolation etc and solve problems based on it.
CO4	Analyze trapezoidal and Simpson's rule for double integration
CO5	Evaluate the ordinary differential equations by numerical methods such as Euler method, Runge Kutta method.
CO6	Formulate Numerical integration based on Gauss Legendre and Gauss Chebyshev Integration Methods

UNIVERSITY EXAM QUESTION PAPER PATTERN:**Max. Marks : 70****Exam Duration : 3 Hrs.****PART A :** 4 Questions of 5 marks each – No choice

20 Marks

PART B : 2 Questions from each unit of internal choice, each carrying 10 marks

50 Marks

SMTA6301	MAT LAB PROGRAMMING LAB	L	T	P	Credits
		0	0	4	2

LIST OF EXPERIMENTS

1. Introduction to MATLAB
2. Study of Vector and Matrix Operations
3. Determination of roots of a polynomial
4. Solution of Linear equations for Underdetermined and Overdetermined cases.
5. Determination of Eigen values and Eigen vectors of a Square matrix.
6. Determination of polynomial using method of Least Square Curve Fitting.
7. Numerical Differentiation and Partial Differentiation
8. Numerical Integration and Double integration
9. Solution of differential equation using 4th order Runge- Kutta method.
10. Solution of differential equation using Taylor's series method.
11. Solution of implicit Runge kutta method

References

1. Fausett L.V. (2007) Applied Numerical Analysis using MATLAB, 2nd Edition, Pearson Education.
2. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Edition, McGraw Hill

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Understand the basics of MAT lab
CO2	Applying MAT lab complex problems can be break up into simpler problem
CO3	Differentiate the study of vector and matrix operators
CO4	Determining the eigen values and eigen vectiors of a square matrix.
CO5	Evalute solution of numerical integration and differentiation
CO6	Produce the polynomial using MAT lab for least square curve fitting

SMTA5402	STATISTICAL INFERENCE AND STOCHASTIC PROCESS	L	T	P	CREDIT
		3	1	0	4

UNIT 1 THEORY OF ESTIMATION**10 Hrs**

Properties of estimates; asymptotically most efficient estimates; Likelihood function; Cramer-Rao inequality; Rao-Black-Well's theorem; Properties of Maximum likelihood estimates. Problems related to Maximum likelihood estimates.

UNIT 2 THEORY OF HYPOTHESIS**10 Hrs**

Power function and OC function; Errors; Most Powerful test; Uniformly Most Powerful test; Unbiased test; Neyman-Pearson fundamental Lemma; Problem.

UNIT 3 NON-PARAMETRIC TEST**10 Hrs**

Introduction; Kolmogorov Smirnov test for two samples; sign test; Wald-Wolfowitz Run test; Median test for two samples and Mann-Whitney U-test.

UNIT 4 DESIGN OF EXPERIMENTS**10 Hrs**

Analysis of variance, One-way classification; Two way classification; Principles of Experimental design; CRD, RBD and LSD and simple problems.

UNIT 5 STOCHASTIC PROCESSES**10 Hrs**

Specification of SP; Markov chain; transition probabilities; Determination of high order transition probabilities; Chapman-Kolmogorov equation; Poisson processes (introduction only).

Max Hrs: 50 Hrs**REFERENCE BOOKS:**

1. Marek Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, 1963.
2. H.C. Saxena & P.V. Surendran, Statistical Inference, S. Chand.
3. S.C. Gupta & V.K. Kapoor, Fundamentals of Applied Statistics, S. Chand.
4. J. Medhi, Stochastic Processes, New Age International Publishers.
5. W. Feller, An Introduction to Probability Theory and its Applications, Volume I, Third Edition, Wiley, 1968.
6. J.L. Doob, Stochastic Processes, Wiley Inter Science, 1990.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define Cramer-Rao inequality, Rao-Black-Well's theorem, Maximum likelihood estimates, Power function and OC function, Non-Parametric test, Stochastic processes, Markov chain, List the characteristics of a best Estimator and properties of MLE.
CO2	Derive Cramer-Rao inequality; Rao-Black-Well's theorem, Neyman-Pearson fundamental Lemma Explain Kolmogorov Smirnov test for two samples; Sign test; Wald-Wolfowitz Run test; Median test for two samples and Mann-Whitney U-test.
CO3	Choose the appropriate Experimental design and solve the ANOVA problem. Choose the non-parametric test to solve the problem.
CO4	Analyze using one-way and two-way ANOVA. Distinguish between CRD, RBD and LSD.
CO5	Evaluate problems on Maximum Likelihood Estimators, Non-parametric tests, Stochastic process and Poisson Process.
CO6	Design ANOVA, Non Parametric Tests, Transition Probability matrix and Poisson Processes.

UNIVERSITY EXAM QUESTION PAPER PATTERN:**Max. Marks : 70****Exam Duration : 3 Hrs****PART A :** 4 questions of 5 marks each – No choice -

20 marks

PART B : 5 questions from each unit of internal choice, each carrying 10 marks -

50 marks

SMTA5403	ADVANCED OPERATIONS RESEARCH	L	T	P	CREDIT
		3	1	0	4

UNIT 1 SENSITIVITY ANALYSIS**10 Hrs**

Introduction–Sensitivity Analysis–Change in Objective Function Coefficient–Change in the Availability of Resources–Changes in the Input Output Coefficients– Addition of New Variable–Addition of New Constraint

UNIT 2 INTEGER LINEAR PROGRAMMING**10 Hrs**

Introduction – Types of Integer Programming Problems – Enumeration and Cutting Plane Solution Concept – Gomory's All Integer Cutting Plane Method - Gomory's Mixed Integer Cutting Plane Method.

UNIT 3 GOAL PROGRAMMING**10 Hrs**

Introduction– Difference between LP and GP approach– Concept of Goal Programming–Goal Programming model formulation– Single Goal with Multiple subGoals–Equally ranked Multiple Goals–Ranking and Weighting of Unequal Multiple Goals–General GP Model– Graphical Solution method of GP –Modified Simplex Method of GP.

UNIT 4 DECISION AND GAME THEORY**10 Hrs**

Decision Theory–Introduction–Steps of Decision making process–Types of Decision Making Environments–Decision Making Under Uncertainty–Decision Making Under Risk –Expected Monetary Value.Theory of Game–Introduction–Two Person Zero Sum Games–Games with Saddle Point–Rules to determine Saddle point- Games without Saddle Point- related problems – Principles of Dominance–Solution method for Games without Saddle point –Graphical Method.

UNIT 5 DYNAMIC PROGRAMMING**10 Hrs**

Introduction–Dynamic Programming Terminology–Developing Optimal Decision Policy–The General Algorithm–Dynamic Programming Under Certainty–Model-I Shortest Route Problem–Model-II, Multiple Separable Return Function and Single Additive Constraint Dynamic Programming Approach for Solving Linear Programming Problems.

REFERENCE BOOKS:

1. J.K.Sharma, Operations Research Theory and Applications ,Fourth Edition, Macmillan India Ltd., 2010
2. Prem Kumar Gupta and D.S.Hira, Operations Research, S Chand, 2000.
3. Kantiswarup, P.K Gupta and Manmohan, Operations Research, Sultan Chand & Sons, 2009

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define sensitivity analysis, Integer linear programming, Goal programming ,Two person zero sum games, Dynamic programming
CO2	Explain change in objective function, input output coefficients, addition of new constraints, principal of dominance, algorithm of dynamic programming under certainty
CO3	Choose an appropriate method and solve the problems in sensitivity analysis and prepare an integer programming table and goal programming to solve the problem.
CO4	Distinguish between ILP and GP and analyze the methods and also estimate problems of game theory using graphical method
CO5	Evaluate problems on Sensitivity analysis, Integer programming problem, Goal programming and Dynamic Programming
CO6	Design solutions using iteration method and graphical method and also Developing ILP, GP and DP model

UNIVERSITY EXAM QUESTION PAPER PATTERN**Max. Marks : 70****Exam Duration : 3 Hrs****PART A :** 4 questions of 5 marks each – No choice -

20 marks

PART B : 5 questions from each unit of internal choice, each carrying 10 marks -

50 marks

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**MSC MATHEMATICS
SYLLABUS**

**SCHOOL OF SCIENCE AND HUMANITIES
DEPARTMENT OF MATHEMATICS**

SCS1202	OBJECT ORIENTED PROGRAMMING	L	T	P	CREDIT
		2	1	0	3

Objective:

- To understand the fundamental concepts of object oriented programming.
- Be familiar with concepts like abstraction, inheritance, polymorphism.
- To understand the concept of Classes.

UNIT I INTRODUCTION TO OBJECT ORIENTED PROGRAMMING**9 hrs.**

Object Oriented Programming Paradigms - Comparison of Programming Paradigms – Object Oriented Languages - Benefits of Object Oriented Programming - Comparison with C - Overview of C++ -Pointers- Functions - Scope and Namespaces - Source Files and Programs.

UNIT II CLASSES AND OBJECTS**9 hrs.**

Working with classes – Classes and objects – Class specification-Class objects-Accessing class members-Defining class members-Inline functions-Accessing member functions within class-Data hiding-Class member accessibility-Empty classes,

UNIT III CONSTRUCTORS AND OVERLOADING**9 hrs.**

Default constructors-Parameterized constructors-Constructor overloading-Copy constructors-new, delete operators-"this" pointer-friend classes and friend functions-Function overloading- Unary Operator overloading -Binary Operator overloading.

UNIT IV INHERITANCE**9 hrs.**

Base class and derived class relationship-Derived class declaration-Forms of inheritance-Inheritance and member accessibility-Constructors in derived class-Destructors in derived class-Multiple inheritance-Multi level inheritance-Hybrid inheritance-Virtual base classes-Member function overriding-Virtual functions-Abstract classes-Pure Virtual functions.

UNIT V I/O AND LIBRARY ORGANIZATION**9 hrs.**

I/O Stream - File I/O - Exception Handling - Templates - STL – Library Organization and Containers – Standard Containers - Overview of Standard Algorithms-Iterators and Allocators.

Max Hrs: 45 hrs.**REFERENCES:**

1. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill, 4th Edition, 2010
 2. Venu Gopal.K.R, Ravishankar.T, and Raj kumar, "Mastering C++", Tata McGraw Hill, 1999.
 3. Bjarne Stroustrup, "The C++ programming language", Addison Wesley, 3rd Edition, 1998.
 4. John R Hubbard, "Programming with C++", Schaums Outline Series, McGraw Hill, 2nd edition, 2009.
- James Martin & James J.Odell, "Object Oriented methods-A foundation", Prentice Hall, 1997.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Demonstrate object-oriented problem-solving and programming principles
CO2	Outline the C++ programming language's most important features and aspects
CO3	Use concepts such as class, method, constructor, instance, data abstraction, function abstraction, inheritance, overriding, overloading, and polymorphism to solve problems.
CO4	In complex programming situations, use virtual and pure virtual functions
CO5	Using the techniques covered in the course, analyze, write, debug, and test basic C++ programs
CO6	Able to address a variety of problems using various object-oriented concept

UNIVERSITY THEORY EXAM QUESTION PAPER PATTERN

Max. Marks:70

Part A: 10 questions of 2 marks each – No choice

Part B: 2 questions from each unit of internal choice, each carrying 10 marks

Exam Duration: 3 hrs.

20 marks

50 marks

SCS4201	OBJECT ORIENTED PROGRAMMING LAB	L	T	P	CREDIT
		0	0	4	2

Objective:

- To understand the fundamental concepts of object oriented programming.
- Be familiar with concepts like abstraction, inheritance, polymorphism.
- To understand the concept of Classes.

List of Experiments

1. Develop a C++ program to implement a class, object creation, member function invocation concept.
2. Develop a C++ program to implement the various constructors and destructor concept.
3. Develop a C++ program to implement a friend function, Inline function.
4. Develop a C++ program to implement an operator (Unary & Binary) overloading concept.
5. Develop a C++ program to implement a function overloading concept.
6. Develop a C++ program to implement a run time polymorphism.
7. Develop a C++ program to implement the following inheritance types.
 - a. Single
 - b. Multiple
 - c. Multilevel
 - d. Hierarchical
 - e. Hybrid
8. Develop a C++ program to implement an Abstract class concept.
9. Develop a C++ program to implement a Virtual function.
10. Develop a C++ program to find the number of characters in a file.
11. Develop a C++ program to handle the exceptions.

Case Study

1. Categorization of living beings as humans, animals, birds, insects, etc., using inheritance.
2. Develop user defined manipulator for the following named
 - a) Rupees for displaying Rs. and sets the precision to 2.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Develop and object-oriented paradigm with concepts of streams, classes, functions, data and objects
CO2	Develop a Program to initialize and destroy objects using Constructor, destructor function
CO3	Build a program using the concept of function overloading and operator overloading
CO4	Implement Inheritance concept in real time applications
CO5	Construct a program using Abstract Class and Virtual function
CO6	Create an application using C++ for implementing File and Exceptional Handling

SMT5113	ADVANCED NUMERICAL METHODS	L	T	P	CREDIT
		3	1	0	4

Objective of the Course: The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1: 12 Hrs

Transcendental and Polynomial Equations: Iteration method based on Second degree equations: The Chelyshev Method – Multipoint Iteration Methods – The Bridge Vieta Method – The Baristow Method – Gdäeffe's dōot SāuađiŶg Method.

UNIT 2: 12 Hrs

System of Algebraic Equations and Eigen Value Problems: Iteration Methods-Jacobi Method, Guass Seidel Method, Successive Over Relaxation Method – Iterative Method for A^{-1} – Eigen Values and Eigen Vectors – Jacobi Method for symmetric Matrices, Power Method.

UNIT 3: 12 Hrs

Interpolation and Approximation – Hermite Interpolation – Piecewise cubic Interpolation and cubic Spline interpolation – Bivariate interpolation – Lagrange and Newton's Bivariate interpolation – Least Square approximation – Gram-Schmidt Orthogonalizing Process.

UNIT 4: 12 Hrs

Differentiation and Integration; Numerical Differentiation – Methods Based on Interpolation – Partial Differentiation – Numerical Integration – Methods Based on Interpolation – Methods Based on Undetermined Coefficients – Gauss Quadrature methods - Gauss Legendre and Gauss Chebyshev Integration Methods – Double Integration – Trapezoidal and Simpson's Rule – Simple Problems.

UNIT 5: 12 Hrs

Ordinary Differential Equations: Numerical Methods – Euler Method – Backward Euler Method – Mid-Point Method – Runge kutta Methods – Implicit Runge Kutta Methods – Predictor – Corrector Methods.

Total No of Hours: 60

TEXT BOOK :

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Fourth Edition.

UNIT I	Chapter II	Sec. 2.4, 2.9
UNIT II	Chapter III	Sec. 3.4, 3.7, 3.11
UNIT III	Chapter IV	Sec. 4.5, 4.6, 4.7, 4.9
UNIT IV	Chapter V	Sec. 5.2, 5.5, 5.6, 5.7, 5.8, 5.11
UNIT V	Chapter VI	Sec. 6.3, 6.4, 6.7

REFERENCE BOOKS:

1. Samuel. D. Conte and Carl De Boor, Elementary Numerical Analysis, Third Edition, 1965.
2. F.B.Hildebrand, Introduction to Numerical Analysis, TMH, 1979.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Recall transcendental and polynomial equations and solve it by different methods such as Chebyshev Method ,Multipoint Iteration Methods , Beirge Vieta Method, Baristow Method ,Graeffe's root Squaring Method to the Second degree equation
CO2	Summarize the different method for solving eigen value, eigen vector and inverse of A^{-1} for system of algebraic equations
CO3	Choose appropriate interpolation formula such as Lagrange, Newton's Bivariate interpolation etc and solve problems based on it.
CO4	Analyze trapezoidal and Simpsons rule for double integration
CO5	Evaluate the ordinary differential equations by numerical methods such as Euler method, Runge Kutta method.
CO6	Formulate Numerical integration based on Gauss Legendre and Gauss Chebyshev Integration Methods

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max. Marks : 70

Part A : 4 questions of 5 marks each – No choice -

Part B : 5 questions from each unit of internal choice, each carrying 10 marks -

Exam Duration : 3 Hrs

20 marks

50 marks

SMT5115	LATEX AND MATHEMATICA	L	T	P	CREDIT
		3	1	0	4

Objective of the Course: Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

Unit – I INTRODUCTION TO LATEX: Special Characters, Document layout and organization – Document class, Page style, Parts of the document, Centering and indenting, Lists, Theorem-like declarations, Boxes, Tables.

Unit – II: Footnotes and marginal notes, Mathematical formulas – Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements, Fine-tuning mathematics, Drawing pictures with LATEX.

Unit – III: INTRODUCTION TO MATHEMATICA Running Mathematica - Numerical calculations – Building up calculations – Using the Mathematica system – Algebraic calculations - Symbolic mathematics - Numerical mathematics.

Unit – IV: ADVANCED MATHEMATICS IN MATHEMATICA Numbers - Mathematical functions – Algebraic manipulation – Manipulating equations - Calculus.

Unit – V: Series, limits and residues - Linear algebra.

Text Book: A Guide to LATEX by **H. Kopka** and **P.W. Daly**, Third Edition, Addison – Wesley, London, 1999.

Unit I : Chapter 2: Section: 2.5, Chapter 3: Sections: 3.1 - 3.3, Chapter 4: Sections: 4.2, 4.3, 4.5, 4.7, 4.8.

Unit II : Chapter 4: Sections: 4.10, Chapter 5: Sections: 5.1 - 5.5, Chapter 6: Section: 6.1. "The Mathematica Book" by **S. Wolfram**, Fourth Edition, Cambridge University Press, Cambridge, 1999.

Unit-III: Chapter 1: Sections: 1.0 - 1.6.

Unit-IV: Chapter 3: Sections: 3.1 - 3.5.

Unit-V : Chapter 3: Sections: 3.6 - 3.7.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Demonstrate the Basic LaTeX
CO2	Identify the footnotes, marginal notes and customized commands.
CO3	Apply Mathematica for numerical calculations
CO4	Analyze the mathematical functions and algebraic simplifications
CO5	Evaluate the limits and series sum
CO6	Create the concepts on linear algebra.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks:70

Part A: 10 questions of 2 marks each – No choice

Part B: 2 questions from each unit of internal choice, each carrying 10 marks

Exam Duration: 3 hrs.

20 marks

50 marks

SMT5201	FOUNDATIONS OF MATHEMATICS			L	T	P	CREDITS	TOTAL MARKS
				3	1	0	4	100

Objective of the Course: Understand the basic rules of logic, including the role of axioms or assumptions and appreciate the role of mathematical proof in formal deductive reasoning and able to distinguish a coherent argument from a fallacious one, both in mathematical reasoning and in everyday life.

UNIT I**13 Hours**

Pre-requisites: Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and the counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set (Quick review). Cartesian product of two and more sets, relations. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections (As in section 1.7 of Text book 1).

UNIT II**12 Hours**

Relations: Product set, Relations (Directed graph of relations on set is omitted). Composition of relations, Types of relations, Partitions, Equivalence relations with example of congruence modulo relation, Partial ordering relations, n-ary relations. (As in Chapter 3 of text book 2 excluding 3.7).

UNIT III**13 Hours**

Functions Pre-requisites: Basic ideas such as domain, co-domain and range of functions. Equality of functions, Injection, Surjection and Bijection (Quick review). Syllabus: Identity function, constant functions, product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions (As in Chapter 4 of text book 2). Indexed collection of sets, Operations on indexed collection of sets (As in 5.1, 5.2 and 5.3 of text book 2). Special kinds of functions, Associated functions, Algorithms and functions, Complexity of Algorithms (As in Chapter 5.7 of text book 2). Equipotent sets, Denumerable and countable sets, Cardinal numbers (Definitions and examples only as in 6.1, 6.2, 6.3 and 6.5 of text book 2).

UNIT IV**11 Hours**

Basic Logic-1 Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. **Predicates and quantifiers**: Introduction, Quantifiers, Binding variables and Negations. (As in Chapter 1 of Text book 1).

UNIT V**11 hours**

Basic Logic-2 Methods of proof: Rules of **inference**, valid arguments, methods of proving theorems; direct proof, proof by contradiction, proof by cases, proofs by **equivalence**, existence proofs, uniqueness proofs and counter examples. (As in Chapter 1 of Text book 1).

TEXT BOOKS

1. K.H. Rosen: Discrete Mathematics and its Applications (fifth edition), Tata McGraw Hill Publishing Company, New Delhi.
2. S. Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi.

1. P.R. Halmos: Naive Set Theory, Springer.
2. E. Kamke, Theory of Sets, Dover Publishers.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify and manipulate basic mathematical objects such as sets, relations, functions. Also verify its simple mathematical properties
CO2	Analyze the properties of functions to application problems by determining the domain and range of a discrete or non-discrete functions
CO3	Analyze the different properties of special functions and able to determine the properties accordingly.
CO4	Evaluate logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic. Express a logic sentence in terms of predicates, quantifiers and logical connectives
CO5	Construct different kinds of proof for any given problem and analyze them accordingly and appreciate the role of mathematical proof in formal deductive reasoning and able to distinguish a coherent argument from a fallacious one, both in mathematical reasoning and in everyday life.
CO6	Design the different research proof and interpret the analyzed data using different types of proof.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks:70

Exam Duration: 3 hrs.

Part A: 10 questions of 2 marks each – No choice

20 marks

Part B: 2 questions from each unit of internal choice, each carrying 10 marks

50 marks

SMT5203	MATHEMATICAL STATISTICS	L	T	P	CREDIT
		3	1	0	4

Objective of the Course: The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1: 12 Hrs

Axiomatic Probability-Conditional Probability- Bayes's theorem- Independent events- Simple results- Inequalities and Problems.

UNIT 2: 12 Hrs

Concept of two dimensional random variables- Marginal and conditional distributions- Independent random variables- Expected values, moments and Liapunov's inequality on absolute moments- Chebyshev's inequality; Markov inequality; conditional expectation.

UNIT 3: 12 Hrs

Characteristic function and moments- Properties- Inversion theorem of characteristic functions- Moment generating function and probability generating function- probability distributions such as Normal, Gamma, Beta, Cauchy and Laplace.(Simple derivations only).

UNIT 4: 12 Hrs

Stochastic convergence- Bernoulli law of large Numbers- Poisson, Chebyshev's and Khintchine's law of large numbers- Strong law of large numbers, Kolmogorov inequality- Kolmogorov theorem; Borel-Cantelli lemma.

UNIT 5: 12 Hrs

Levy-Cramer theorem- Central limit theorems such as De Moivre Laplace, Lindeberg Levy and Liapunov. Comparison between central limit theorems and law of large numbers.

Total No of Hours: 60

TEXT BOOK :

1. Marek Fisz, Probability theory and Mathematical Statistics, Third Edition, John Wiley & Sons, 1963.

UNIT I	Chapter 1.1 to 1.7
UNIT II	Chapter 2.1 to 2.8; 3.1 to 3.4
UNIT III	Chapter 4.1 to 4.5, 4.7; 5.7 to 5.10
UNIT IV	Chapter 6.1 to 6.4; 6.11 & 6.12
UNIT V	Chapter 6.6 to 6.10

REFERENCE BOOKS:

1. Murray R. Spiegel, John Jschiller, R. Alu Srinivasan Probability and Statistics, Third Edition, Shaw's Outlines Series, 2010.
2. B.R.Bhat, Modern Probability Theory Revised Third Edition, New Age International, 2005.

Course Outcomes: At the end of the course, the student will be able to:

CO1	CO1 Define basic probabilities. List the additive and multiplicative laws on probability, types of correlations. Identify the sample tests , mean and confidence limits
CO2	Explain functions of random variables, their probability distributions and probability generating functions. Explain and derive the mean and variance of the distributions.
CO3	Choose appropriate probability theorem and solve the problems. Prepare the cumulative distribution for random variables. Applications of parameters of standard distributions.
CO4	Evaluate stochastic convergence and Bernoulli's law of large numbers.
CO5	CO5 Evaluate the central limit theorem.
CO6	CO6 Apply Levy cramer theorem

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max. Marks : 70

Part A : 4 questions of 5 marks each – No choice -

Part B : 5 questions from each unit of internal choice, each carrying 10 marks -

Exam Duration : 3 Hrs

20 marks

50 marks

SMT5205	FUZZY ANALYSIS	L	T	P	CREDIT
		3	1	0	4

Objective of the Course: The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1: SMT5206**12 Hrs**

From Classical Sets To Fuzzy sets – Fuzzy set: Basic types – Fuzzy sets Versus Crisp sets- Extension Principle for fuzzy sets – Operations on Fuzzy sets – Types of operations – Fuzzy complements.

UNIT 2:**12 Hrs**

Fuzzy Arithmetic – Fuzzy numbers - Linguistic variables – Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers – Lattice of Fuzzy numbers – Fuzzy equations.

UNIT 3:**12 Hrs**

Fuzzy Logic – Multi-valued Logics – Fuzzy Propositions – Unconditional and Unqualified Fuzzy propositions – Unconditional and qualified Propositions – Conditional and Unqualified propositions – Conditional and Qualified propositions – Linguistic Hedges – Inference from conditional Fuzzy propositions- Inference from conditional and qualified propositions.

UNIT 4:**12 Hrs**

Fuzzy Decision making – Individual decision making – Fuzzy Ranking methods – Fuzzy Linear programming.

UNIT 5:**12 Hrs**

Fuzzy Relations – composition of fuzzy relations – properties of fuzzy relations.

Total No of Hours: 60**TEXT BOOK :**

T.B-1: George J.Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, PHI,2004.

T.B-2: A.Nagoor Gani and V.J.Chandrasekaran, A first look at Fuzzy Graph Theory, Allied Publishers Pvt. Ltd.

UNIT I Chapter 1 - 1.3,2.3 & Chapter 3 - 3.1&3.2

T.B-1

UNIT II Chapter 4 – 4.1,4.2,4.3,4.4,4.5,4.6

T.B-1

UNIT III Chapter 8 – 8.2,8.3,8.5,8.6,8.7

T.B-1

UNIT IV Chapter 15 – 15.2,15.6,15.7

T.B-1

UNIT V Chapter 1 – 1.3,1.4,1. 5

T.B-2**REFERENCE BOOKS:**

1. Timothy J.Ross, Fuzzy Logic with Engineering Applications –McGraw-Hill, Inc.,

H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, 1991.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define the fuzzy set and list the various operations on fuzzy set.
CO2	Give examples for linguistic variables
CO3	Explain arithmetic operations on intervals, fuzzy numbers with examples
CO4	Distinguish different type of fuzzy proposition with example
CO5	Evaluate fuzzy ranking method for individual decision making and group decision making.
CO6	Construct the composition of fuzzy relation and develop the properties of fuzzy relation

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max. Marks : 70

Part A : 4 questions of 5 marks each – No choice -

Part B : 5 questions from each unit of internal choice, each carrying 10 marks -

Exam Duration : 3 Hrs

20 marks

50 marks

SMT5206	SPSS AND TORA LAB	L	T	P	CREDIT
		3	1	0	4

COURSE OBJECTIVE: To have hands- on experience on decision modeling. Knowledge of spreadsheets and data analysis software. Spreadsheet Software and Data Analysis Tools.

S.No.	Exp. No	Name of experiments	Duration
1	1	Descriptive Statistics	4
2	2	Hypothesis – Parametric	4
3	3	Hypothesis – Non-parametric	4
4	4	Correlation & Regression	4
5	5	Forecasting	4
6	-	Extended experiment – 1	4
7	6	Portfolio Selection	4
8	7	Risk Analysis & Sensitivity Analysis	4
9	8	Revenue Management	4
10	-	Extended experiment – 2	4
11	9	Transportation & Assignment	4
12	10	Networking Models	4
13	11	Queuing Theory	4
14	12	Inventory Models	4
15	-	Extended experiments – 3	4

TEXT BOOKS

1. David M. Levine et al, Statistics for Managers using MS Excel,(6thEdition) Pearson, 2010
2. David R. Anderson, et al, An Introduction to Management Sciences, Quantitative approaches to Decision Making, (13th edition), South-Western College Pub, 2011.
3. William J. Stevenson, Ceyhun Ozgur, Introduction to Management Science with Spreadsheet, Tata McGraw Hill, 2009.
4. Wayne L. Winston, Microsoft Excel 2010, Data Analysis & Business Modeling, 3rd edition, Microsoft Press, 2011.
5. Vikas Gupta, Comdex Business Accounting with Ms Excel, 2010 and Tally ERP 9.0 Course Kit, Wiley India, 2012
6. Kiran Pandya and Smriti Bulsari, SPSS in simple steps, Dreamtech, 2011.

Course Outcome : At the end of the course the students will be able to:

CO1	List the window types provided in SPSS and TORA. Define the categorical variables available in SPSS.
CO2	Apply Statistical modelling to draw meaningful conclusions from data and develop programming skills using the statistical computing software SPSS and operation research software TORA
CO3	Choose appropriate fundamental data manipulation procedures in building models for real world problem.
CO4	Distinguish between nominal, ordinal and scale variables. Categorize the parametric and non-parametric tests. Differentiate between correlation and regression.
CO5	Evaluate the future values of real time models using SPSS and estimate the error between the observed and expected values.
CO6	Design the research layout and interpret the analysed data using figures and tables.

SMT5207	ADVANCED GRAPH THEORY	L	T	P	CREDIT
		3	1	0	4

Objective of the Course: The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1: 12 Hrs

Connectivity and edge-connectivity – 2-connected graphs – Menger's theorem.

UNIT 2: 12 Hrs

Matching – System of Distinct Representatives and Marriage problem – Covering - 1-factor – Stable Matching

UNIT 3: 12 Hrs

Independent sets – Edge-colourings – Vizing's Theorem – Vertex Colourings – Uniquely Colourable graphs – Critical graphs

UNIT 4: 12 Hrs

Predecessor and Successor – Algorithm – Graceful Labeling – Sequential functions Magic graphs – Conservative graphs

UNIT 5: 12 Hrs

Perfect Graphs – the Perfect Graph Theorem – Chordal Graphs – Interval Graphs – Comparability Graphs .

Total No of Hours: 60

TEXT BOOK :

M. Murugan, Topics in Graph theory and Algorithms, Muthali Publishing House, Annanagar, Chennai, First Edition, 2003.

UNIT I	Chapter 3	Sec. 3.1 to 3.3
UNIT II	Chapter 6	Sec 6.1 to 6.5
UNIT III	Chapter 7	Sec 7.1,7.2,7.4 to 7.7
UNIT IV	Chapter 10	Sec 10.1 to 10.4,10.6 & 10.7
UNIT V	Chapter 12	Sec 12.1 to 12.5

REFERENCE BOOKS:

1. S. A. Choudum, Graph Theory, Macmillan India Limited.
2. F. Harary, Graph Theory, Narosa Publishing House, 2001.

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max. Marks : 70

Part A : 4 questions of 5 marks each – No choice -

Part B : 5 questions from each unit of internal choice, each carrying 10 marks -

Exam Duration : 3 Hrs

20 marks

50 marks

CO1	Define connectedness, matching, covering, coloring and labeling in graphs
CO2	Explain the relation between independence number and covering number in a graph. And perfectness in graphs. Illustrate various labeling of graphs.
CO3	Explain Mengers theorem on Connectedness Berge theorem on Matching. Perfectness of Chordal graphs, Interval graphs, Comparability graphs. The perfect graph theorem.
CO4	Compare Connectivity and connectedness in graphs and maximum matching and minimum matching in a graph. Hence deduce a relation between the parameters.
CO5	Evaluate stable matching for the given data. Evaluate graceful labeling, Magic labeling, Sequential labeling and $L(2,1)$ labeling of different graphs.
CO6	Create a Characterization for 2- connectedness in graphs , Matchings in Bipartite graphs.

SMT5208	STATISTICAL INFERENCE AND STOCHASTIC PROCESS	L	T	P	CREDIT
		3	1	0	4

Objective of the Course: . Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1: **12 Hrs**

Theory of Estimation; Properties of estimates; asymptotically most efficient estimates; Likelihood function; Cramer-Rao inequality; Rao-Black-Well's theorem; Properties of Maximum likelihood estimates. Problems related to Maximum likelihood estimates.

UNIT 2: **12 Hrs**

Theory of Hypothesis; Power function and OC function; Errors; Most Powerful test; Uniformly Most Powerful test; Unbiased test; Neyman-Pearson fundamental Lemma; Problem.

UNIT 3: **12 Hrs**

Non-Parametric test; Introduction; Kolomogorov Smirnov test for two samples; sign test; Wald –Wolfowiz Run test; Median test for two samples and Mann-Whitney U-test.

UNIT 4: **SMT5201** **12 Hrs**

Analysis of variance, One-way classification; Two way classification; Principles of Experimental design; CRD, RBD and LSD and simple problems.

UNIT 5: **12 Hrs**

Stochastic processes; specification of SP; Markov chain; transition probabilities; Determination of higher order transition probabilities; Chapman-Kolmogorov equation; Poisson processes (introduction only).

Total No of Hours: 60

TEXT BOOK :

T.B-1 Marek Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, 1963.

T.B-2 H.C. Saxena & P.V. Surendran, Statistical Inference, S.Chand.

T.B-3 S.C. Gupta & V.K. Kapoor, Fundamentals of Applied Statistics, S.Chand.

T.B-4 J.Medhi, Stochastic Processes, New Age International Publishers.

UNIT I Section-13.1 to 13.7 **T.B-1**

UNIT II Section-16.1 to 16.5 **T.B-1**

UNIT III Section-7.3.1 to 7.3.6 and 7.9 **T.B-2**

UNIT IV Section-5.1 to 5.3; 6.3.1, 6.3.2, 6.4, 6.5, 6.5.1, 6.6, 6.6.1 & 6.7 **T.B-3**

UNIT V Section-2.1, 2.2; 3.1 to 3.4; 4.1 **T.B-4**

REFERENCE BOOKS:

1. W.Feller, An Introduction to Probability Theory and its Applications, Volume I, Third Edition, Wiley, 1968.
2. J.L. Doob, Stochastic Processes, Wiley InterScience, 1990.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define Cramer-Rao inequality , Rao-Black-Well's theorem, Maximum likelihood estimates, Power function and OC function, Non-Parametric test, Stochastic processes, Markov chain, List the characteristics of a best Estimator and properties of MLE.
CO2	Derive Cramer-Rao inequality; Rao-Black-Well's theorem , Neyman-Pearson fundamental Lemma Explain Kolomogorov Smirnov test for two samples; Sign test; Wald –Wolfowitz Run test; Median test for two samples and Mann-Whitney U-test.
CO3	Choose the appropriate Experimental design and solve the ANOVA problem. Choose the non-parametric test to solve the problem.
CO4	Analyze using one-way and two-way ANOVA. Distinguish between CRD, RBD and LSD.
CO5	Evaluate problems on Maximum Likelihood Estimators, Non- parametric tests, Stochastic process and Poisson Process.
CO6	Design ANOVA ,Non Parametric Tests, Transition Probability matrix and Poisson Processes.

UNIVERSITY EXAM QUESTION PAPER PATTERN:

Max. Marks : 70

Part A : 4 questions of 5 marks each – No choice -

Part B : 5 questions from each unit of internal choice, each carrying 10 marks -

Exam Duration : 3 Hrs

20 marks

50 marks

SMT5209	NUMBER THEORY AND LINEAR ALGEBRA	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Objective of the Course: The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT I**12 Hours**

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation $ax + by = c$. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.

(Sections 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 4.2, 4.3 & 4.4 of Text 1).

UNIT II**12 Hours**

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function. (Sections 5.2, 5.3, 6.1, 6.3, 7.2, 7.3 and 7.4 of Text 1) (Theorems 7.6 and 7.7 only).

UNIT III**12 Hours**

Rank of a matrix – Elementary transformation, reduction to normal form, row reduced echelon form. Computing the inverse of a non singular matrix using elementary row transformation. (Section 4.1 to 4.13 of Text 2)

UNIT IV**12 Hours**

System of linear homogeneous equations. Null space and nullity of matrix. Sylvester's law of nullity. Range of a matrix. Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix.

UNIT V**12 hours**

Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix Cayley-Hamilton theorem. (Sections 6.1 to 6.6 and 11.1 to 11.3 and 11.11).

TEXT BOOKS

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.
2. Shanti Narayanan & Mittal : A Text Book of Matrices, Revised edn., S. Chand.

REFERENCE BOOKS

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.
2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.

Course Outcome: At the end of the course, learners would acquire competency in the following skills.

CO1	Learn divisibility property of integers. Distribution of prime numbers. Fundamental theorem of arithmetic. Properties of congruence. Chinese remainder theorem. Application to solve simple problems..
CO2	Prove Fermat's little theorem, Wilson's theorem and their application to simple problems.
CO3	Introduction to number theoretic function and their properties.
CO4	Elementary transformation and their application in solving problems.
CO5	Matrix representation of homogeneous and non-homogeneous equations. Rank, nullity and range of the matrix.
CO6	Characteristic equation and roots of a complex matrix. Cayley Hamilton theorem.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks:70

Exam Duration: 3 hrs.

Part A: 10 questions of 2 marks each – No choice

20 marks

Part B: 2 questions from each unit of internal choice, each carrying 10 marks

50 marks

SMT5210	ADVANCED OPERATIONS RESEARCH	L	T	P	CREDIT
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Objective of the Course: The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1:**12 Hrs**

Sensitivity Analysis: Introduction – Sensitivity Analysis – Change in Objective Function Coefficient – Change in the Availability of Resources – Changes in the Input Output Coefficients – Addition of New Variable – Addition of New Constraint

UNIT 2:**12 Hrs**

Integer Linear Programming: Introduction – Types of Integer Programming Problems – Enumeration and Cutting Plane Solution Concept – Gomory's All Integer Cutting Plane Method - Gomory's Mixed Integer Cutting Plane Method.

UNIT 3:**12 Hrs**

Goal Programming : Introduction – Difference between LP and GP approach – Concept of Goal Programming - Goal Programming model formulation – Single Goal with Multiple sub Goals – Equally ranked Multiple Goals – Ranking and Weighting of Unequal Multiple Goals - General GP Model – Graphical Solution method of GP – Modified Simplex Method of GP.

UNIT 4:**12 Hrs**

Decision and Game Theory: Decision Theory – Introduction – Steps of Decision making process – Types of Decision Making Environments – Decision Making Under Uncertainty - Decision Making Under Risk - Expected Monetary Value. Theory of Game – Introduction – Two Person Zero Sum Games – Games with Saddle Point – Rules to determine Saddle point - Games with out Saddle Point - related problems – Principles of Dominance – Solution method for Games without Saddle point- Graphical Method.

UNIT 5:**12 Hrs**

Dynamic Programming: Introduction – Dynamic Programming Terminology– Developing Optimal Decision Policy – The General Algorithm - Dynamic Programming Under Certainty – Model-I Shortest Route Problem – Model-II, Multiple Separable Return Function and Single Additive Constraint Dynamic Programming Approach for Solving Linear Programming Problems.

Total No of Hours: 60**TEXT BOOK :**

1. J.K. Sharma, Operations Research Theory and Applications, Fourth Edition, Macmillan India Ltd., 2010.

UNIT I	Section 6.1 and 6.2 (6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5)
UNIT II	Section 7.1 to 7.5
UNIT III	Section 8.1 to 8.6
UNIT IV	Section 11.1,11.2,11.3, 11.4 (11.4.1 to 11.4.5), 11.5 (11.5.1) 12.1, 12.2, 12.3(12.3.1), 12.4, 12.5, 12.6(12.6.4)
UNIT V	Section 22.1, 22.2,22.3,22.4(Model - I and Model - II), 22.5

REFERENCE BOOKS:

- Prem Kumar Gupta and D.S. Hira, Operations research, S Chand, 2000.
Kanti swarup, P.K.Gupta and Manmohan, Operations Research, Sultan Chand & Sons, 2009

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define sensitivity analysis, Integer linear programming, Goal programming ,Two person zero sum games, Dynamic programming
CO2	Explain change in objective function, input output coefficients, addition of new constraints, principal of dominance, algorithm of dynamic programming under certainty
CO3	Choose an appropriate method and solve the problems in sensitivity analysis and prepare an integer programming table and goal programming to solve the problem.
CO4	Distinguish between ILP and GP and analyze the methods and also estimate problems of game theory using graphical method
CO5	Evaluate problems on Sensitivity analysis, Integer programming problem, Goal programming and Dynamic Programming
CO6	Design solutions using iteration method and graphical method and also Developing ILP, GP and DP model

UNIVERSITY EXAM QUESTION PAPER PATTERN:**Max. Marks : 70****Part A :** 4 questions of 5 marks each – No choice -**Part B :** 5 questions from each unit of internal choice, each carrying 10 marks -**Exam Duration : 3 Hrs**

20 marks

50 marks