



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of science and Humanities

Department of Mathematics

1.2.1 Courses having focus on Employability / Entrepreneurship / Skill Development

BSc Mathematics

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SMTB4001	MATHEMATICAL STATISTICS	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objectives

To present the general theory of statistical distributions as well as the standard distributions found in statistical practice. To train students with essential tools for statistical analyses by fostering understanding through real-world statistical applications.

UNIT I CONCEPT OF SAMPLE SPACE

9 Hrs

Events, Definition of Probability (Classical, Statistical & Axiomatic) - Addition and Multiplication laws of probability - Independence - Conditional Probability - Bayes' theorem - Simple problems.

UNIT II RANDOM VARIABLES

9 Hrs

(Discrete and Continuous) Distribution function - Expected values & moments - Moment generation function - probability generation functions - Examples.

UNIT III CONCEPTS OF BIVARIATE DISTRIBUTION

9 Hrs

Correlation and regression - Linear prediction - Rank correlation coefficient - Concepts of Partial and Multiple Correlation coefficients - Simple problems.

UNIT IV STANDARD DISTRIBUTIONS

9 Hrs

Binomial, Poisson, Normal and Uniform distributions - Geometric, Exponential, Gamma and Beta distributions. Inter relationship between distributions.

UNIT V SAMPLING THEORY

9 Hrs

Introduction-large sample test based on normal distribution - Sampling distribution of the mean - Confidence limits Test for single mean difference between means, proportion, difference between proportion - small sample test based on t, F distributions - Test for single mean, difference between means, standard deviation, difference between standard deviations - Chi square test for goodness of fit, independence of attributes.

TEXT / REFERENCE BOOKS

- 1 S. C. Gupta & V. K. Kapoor, Fundamental of Mathematical Statistics, 9th Edition, Sultan Chand & Sons New Delhi, 1994.
- 2 P. R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2002. Treatment and Content as in Mathematical Statistics,
- 3 J. N. Kapur and H. C. Saxena, 20th Edition, S. Chan & Co. Ltd., New Delhi, 2010.
- 4 Hogg, R.V. & Craig. A. T. (1998): Introduction to Mathematical Statistics, Macmillan
- 5 T. Veerarajan, Probability, Statistics and Random process, Tata McGraw Hill, 1st reprint, 2004

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

CO1	Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events. Translate real-world problems into probability models.
CO2	Derive the probability density function of transformation of random variables. Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables. Derive the mean and variance of the distributions.

CO3	Calculate and interpret the correlation between two variables. Calculate the simple linear regression equation for a set of data. Utilise the principles of linear regression and correlation, including least square method in predicting a particular value of Y for a given value of X and significance of the correlation coefficient. Analyse the association between the attributes.
CO4	Define binomial outcomes and compute probability of getting X successes in n trials. Identify the characteristics of different discrete and continuous distributions. Identify the type of statistical situation to which different distributions can be applied. Use Poisson, exponential ,Normal distributions to solve statistical problems.
CO5	Use the normal probability distribution including standard normal curve calculations of appropriate areas. Use different distributions to solve simple practical problems. Understand the interdependence between the distributions.
CO6	Formulate null and alternative hypotheses and apply t-tests , F tests and Chisquare tests in real life problems. Compare the hypothetical values in small and large samples.

Employability

SMTB3001	DISCRETE MATHEMATICS	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objective: This course enables the ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Improves logical thinking of the students and apply in different areas.

UNIT I LOGIC**9 Hrs**

Statements and Notations, Connectives ,Negation, Conjunction, Disjunction, statement, Formulae and Truth Tables, Conditional and Bi-conditional, Well-formed Formulae, Tautologies, Equivalence of Formulae, Duality Law Tautological Implications.

UNIT II INFERENCE THEORY**9 Hrs**

Normal Forms, Disjunctive Normal Forms, Conjunctive Normal Forms, Principal Disjunctive Normal Forms, Principal Conjunctive Normal Forms, Rules of Inference, The Predicate Calculus,. Predicates, Variables and Quantifiers, Predicate Formula, Free and Bound Variables.

UNIT III SEMIGROUP AND MONOID**9 Hrs**

Semi groups, Monoids, Homomorphism of Semi groups and Monoids, Sub semi groups and Sub monoid.

UNIT IV LATTICES**9 Hrs**

Lattices as Partially Ordered Set, Properties of Lattices, Lattices as Algebraic Systems, Sublattices, Direct Product and Homomorphism.

UNIT V BOOLEAN ALGEBRA**9 Hrs**

Boolean Algebra, Basic properties, Sub algebra, Direct Product, and Homomorphism, Boolean Functions.

TEXT / REFERENCE BOOKS

1. J. P. Trembley, Manohar, Discrete Mathematical Structures with applications to Compute science ,McGrew Hill Book Co., second edition 2001.
2. Chandrasekaran and M. Uma Parvathi, Discrete Mathematics, Prentice Hall of India, e-Book, 2013.
3. R. Lidland, G. Pilz, Applied Abstract Algebra, SpringerVerla,1984.
4. Ralph P. Grimaldi, Discrete and combinatorial Mathematics: An Applied Introduction, Fourth edition, Pearson Education Asia, Delhi 2002.

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

CO1	Define truth table; list equivalent Propositions, List basic properties of Lattices and Boolean algebra. Identify semigroup and Monoid
CO2	Understand Equivalence Relation, Lagrange's theorem on cyclic group.
CO3	Solve problems on Inference theory for Propositional Calculus and Predicate Calculus. Distinguish PCNF and PDNF. Analyze properties of groups.
CO4	Evaluate problems on implication and Equivalence laws, Analyse Lattices as Algebraic system
CO5	Develop supremum and infimum in Boolean function, . Construct truth table of the compound statements
CO6	Constructing proofs for semigroup, monoid, homomorphism and lattices

Employability

SMTB3008	FORMAL LANGUAGE & AUTOMATA	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objective: Recognise the fundamental properties of formal languages and grammars, distinguish between regular, context-free, and recursively enumerable languages. Create grammars to generate strings in a specific language.

Learn about the theory of computation and computational models.

UNIT I FORMAL LANGUAGES

9

Hrs

Finite Automaton-Definition of finite automaton - Representation of finite automaton- Acceptability of a string by a finite automaton- Languages accepted by a finite automaton.

UNIT II FINITE AUTOMATA

9

Hrs

Non-deterministic finite automaton- Acceptability of a string by NFA- Equivalence of FA and NFA- Procedure for finding an FA equivalent to a given NFA- Properties of regular sets –Decision algorithm for regular sets.

UNIT III GRAMMARS

9

Hrs

Phrase – Structure Grammar derivations - Phrase-Structure languages – Context-sensitive languages (CSL)- Context-free languages (CFL)- Chomskian Hierarchy.

UNIT IV PROPERTIES OF REGULAR LANGUAGE

9

Hrs

Closure Operation- Kleene Closure- Substitutions- Homomorphism-Inverse Homomorphism-Context free language, Derivation trees- Ambiguity leftmost, rightmost derivations.

UNIT V MORE PROPERTIES OF REGULAR LANGUAGE

9 Hrs

Normal forms- Chomsky's normal forms- Problems based on Chomsky's normal forms – uvwxy theorem- Problems based on uvwxy theorem.

TEXT / REFERENCE BOOKS

1. Dr. M. Venkatraman, Dr. N. Sridharan, N. Chandrasekaran," Discrete Mathematics", Chapter 12, Sections 1 to 12.
2. Rani Siromoney, Formal Languages and Automata, The Christian Literature Society, Chennai. Chapter 2, Sections 2.1 to 2.4, Chapter 3, Sections 3.1 to 3.2, Chapter 4, Sections 4.1 to 4.5.
3. John E Hopcroft, Jeffery D, Ullman, Introduction to Automata Theory and Computations, Narosa Publishing House.
4. Ragade B.R, "Automata and Theoretical Computer Science", Pearson Education
5. Bernard M. Moret, "The Theory of Computation", Pearson Education
6. Peter Linz, "An Introduction to Formal Languages and Automata", Jones & Bartlett Publishers

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

CO1	List the languages and strings. Define finite automata.
CO2	Explain the concepts of finite automation and non-deterministic finite automaton.
CO3	Illustrate the process of phrase- structure grammar. Apply methods of context sensitivity languages.
CO4	Examine the decision algorithms for context free languages. Discriminate between Kleene closure and positive closure

C05	Evaluate the problems based on Chomsky's normal forms					
CO6	Formulate uvwxy theorem and problems based on uvwxy theorem					
SMTH1503 Employability	OPERATION RESEARCH	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objective: This course gives students to understand the importance of Operation Research. Develop and Create Problem solving skills for any complex problems..Solve Linear Programming Problems, Transportation and Assignment Problems, Sequencing and Scheduling Problem , Inventory Control Replacement Model.

UNIT I INTRODUCTION TO OR

9 Hrs

Operations Research(OR)-Nature-Characteristics-Phases.-Role of OR in Decision making- Outline of OR Models Linear Programming - definition - mathematical formulation - graphical method.

UNIT II LINEAR PROGRAMMING PROBLEM

9 Hrs

General linear programming problems – canonical and standard forms – simplex method -Two Phase Method - Big M methods. Dual Simplex method - Duality - properties - fundamental theorems of duality(statements only) -principle of duality - dual simplex method.

UNIT III TRANSPORTATION AND ASSIGNMENT PROBLEM

9 Hrs

Transportation problem – Initial Basic feasible solution- Northwest corner method - Least Cost method - Vogel's approximation method –Optimum solution using MODI method - Assignment problems - Travelling salesman problems.

UNIT IV SEQUENCING AND SCHEDULING PROBLEM

9

Hrs

Sequencing Problem with N jobs and 2 machines N Jobs 3 machines N Jobs and m machines and 2 Jobs m machines (Graphical method) - Project Management -Basic concepts–Network construction - Scheduling Critical Path Method (CPM) & Program evaluation review technique (PERT) – simple applications.

UNIT V INVENTORY CONTROL REPLACEMENT MODEL

9 Hrs

Inventory Control - Various Types of inventory models - deterministic inventory models - Production model, Purchase model -with and without shortage - Economic Order Quantity (EOQ) - Buffer stock - Shortage quantity - Probabilistic inventory models – Quantity Discount and Price Breaks.Replacement policy for items whose maintenance cost increases with time- Consideration of time value of money - Replacement policy- Individual, Group replacement of items that fail completely and suddenly.

TEXT / REFERENCE BOOKS

1. Kanthi Swarup, Gupta P.K., Man Mohan, "Operations Research, 12th Edition", Sultan Chand Sons, Educational Publishers, New Delhi, 2004
2. S.D Sharma," operation research Theory, Methods and Application", 17th Edn., Kedar Nath Ram Nath Publication, 2010.
3. Panner Selvam R., "Operations Research", Prentice Hall of India Private Limited, New Delhi, 2006
4. Kalavathy S., "Operations research", 2nd Edition, Vikas Publishing House Private Limited, New Delhi, 2002.

 Employability

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

CO1	List the characteristics of operation research. Identify the decision variables and formulation of linear program. Recall to solve two variable problems.
CO2	Understand the slack and surplus variables to find the optimal solution of an optimization problem. Identify the artificial variable and form a new objective function.
CO3	Apply north west corner, least cost and vogel approximation method on transportation problem. Solve assignment problem using Hungarian method
CO4	Explain how to determine an optimal sequence in which the jobs should be performed on the machines so that the total elapsed time is minimum
CO5	Evaluate the various types of inventory models. Discriminate deterministic and probabilistic models in inventory.
CO6	Formulate the problem involves determining whether to replace them as a group or to replace individuals as they fail.

SMTB1504	DATA ANALYTICS	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objectives: To educate and motivate the students in the field of data analysis. To allow the students to have a deep knowledge in fundamentals of statistics

Unit I Data Definitions and Analysis Techniques

9 Hrs

Elements, Variables, and Data categorization - Levels of Measurement - Data management and indexing - Introduction to statistical learning and R-Programming

Unit II Descriptive Statistics

9 Hrs

Measures of central tendency - Measures of location of dispersions - Practice and analysis with R.

Unit III Estimation of Parameter

9 Hrs

The law of large numbers- The Central limit theorem - Consistency – Unbiasedness - Maximum likelihood estimation – confidence Intervals - Analysis of variance - Practice and analysis with R

Unit Iv Multivariate Analysis

9 Hrs

Multivariate Analysis: Multiple Regression Analysis - Principal Component Analysis – Factor Analysis – Discriminant Analysis – Cluster Methods - Artificial Neural Networks- Nearest Neighbor - Support Vector Machines – Fuzzy Logic - Genetic Algorithm.

Unit V Significance Test

9 Hrs

Likelihood ratio test – Monotone likelihood ratio property and Neyman –Person lemma - Type I and Type II errors Power and Assurance Critical values - Practice and analysis with R.

TEXT / REFERENCE BOOKS

1. D.C. Montgomery & E. Peck- Introduction to Linear Regression Analysis
2. A.M. Mood, F.A. Graybill& D.C. Boes. Introduction to the Theory of Statistics
3. N. Draper & H. Smith- Applied Regression Analysis
- 4 S. M. Ross, “A first course in Probability”, Prentice Hall.
5. I. R. Miller, J.E. Freund and R. Johnson, “Probability and Statistics for Engineers”. Fourth Edition, PHI.
6. A. M. Mood, F.A. Graybill and D.C. Boes, “Introduction to the Theory of Statistics”, McGraw Hill Education.
- 7.. Jared P. Lander- R for Everyone: Advanced Analytics and Graphics

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

CO1	Recall the basics of statistics and identify the level of measurement.
CO2	Estimate the measures of central tendency and location of dispersions using R
CO3	To conduct the Analysis of variance for randomized block design and latin squares using R.
CO4	Distinguish the different types of analysis, also explain about artificial neural networks, fuzzy logic and genetic algorithm.
C05	Evaluate Type I and Type II errors in significance test using R.
CO6	Compose likelihood ratio property and create critical values using R.

	Employability					
SMTB2501	DATA ANALYTICS LAB	L	T	P	CREDITS	TOTAL MARKS
		0	0	3	2	100

Course Objectives: To acquire basic knowledge of R laboratory techniques. To educate the students the basics of data acquisition, data analysis and interpretation of results.

LIST OF EXPERIMENTS

1. Programming Method
2. Implementation using R & R-studio
3. Debugging
4. Library Function, file
5. R statistical programming language
6. Introduction to R, Functions
7. Control flow and Loops
8. Working with Vectors and Matrices
9. Reading in Data, Writing Data
10. Working with Data
11. Manipulating Data
12. Simulation
13. Linear model
14. Data Frame
15. Graphics in R

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

CO1	Able to download R software and R studio software.
CO2	Get familiar with R software and learn basics of R with descriptive statistics. Access online resources for R and import new function packages into the R workspace. Import, review, manipulate and summarize data-sets in R.
CO3	To educate the basics of data acquisition, data analysis and interpretation of results.
CO4	Perform correlation, regression analysis and appropriate statistical tests for real life situations using R
CO5	Fit the distributions to a real-life data using R-software.
CO6	Compute probabilities and fitting of probability distribution with R environment.

SMTB3009	FINANCIAL MATHEMATICS	L	T	P	EL	C
		3	1	0	0	4

- **COURSE OBJECTIVES:**

- The objective of this course is to develop understanding on the concepts associated with financial mathematics
- To comprehend practical applications of interest rate in real life situation

UNIT I PROBABILITY

12 Hrs

Probability – Probabilities and Events – Conditional probability – Random Variables and Expected Values – Convergence and correlation – Continuous Random variables – Normal Random Variables – Properties of Normal Random Variables – The central limit Theorem – Simple Problems.

UNIT II GEOMETRIC BROWNIAN MOTION

12Hrs

Geometric Brownian Motion – G.B.M. as a limit of simple models – Brownian Motion – Simple problems - Interest rates – Present value analysis – Rate of return – Continuation of varying interest rates – An example of option pricing – other examples of pricing via arbitrage.

UNIT III THE ARBITRAGE THEOREM AND BLACK SCHOLES FORMULA

12 Hrs

The Arbitrage theorem – The multi period Binomial model – proof of the Arbitrage theorem - Black Scholes formula – properties of the Black Scholes option cost – Derivation of Black Scholes formula – simple problems.

UNIT IV ADDITIONAL RESULTS ON OPTIONS

12 Hrs

Additional results on options – **Call options on Dividend paying Securities** – Pricing American put options – Adding Jumps to Geometric Brownian Motion – Estimating the Volatility Parameter – Simple problems.

UNIT V VALUING BY EXPECTED UTILITY

12 Hrs

Valuing by Expected Utility – Limitation of Arbitrage pricing – valuing Investments by Expected utility – The portfolio selection problem – Value at risk and conditional value at risk The capital assets pricing model – **Mean variance analysis of risk** – Neutral priced Call options – Rates of return – Single period and Geometric Brownian Motion – simple problems.

Max. Hrs: 60 Hrs

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

- CO1 Identify and approximate probability distribution for a given discrete or continuous random variable and use its properties to calculate probabilities.
- CO2 Relate the continuous time stochastic process using geometric Brownian motion.
- CO3 Apply black schools formula in financial market, which contains derivative investment instruments. Construct Arbitrage theorem to help the investors and financial analyst in price securities
- CO4 Analyze the stock prices, prices of other assets caused by unpredictable events using jumps to geometric Brownian motion.

- CO5 Evaluate the expected utility by taking the weighted average of all possible outcomes under certain circumstances.
- CO6 Compose the invariance principle that a decision maker should not be affected by the way alternates are presented.

TEXT / REFERENCE BOOKS

1. Sheldon .M.Ross, An Elementary Introduction to Mathematical Finance, 2nd Edition, Cambridge University press, 2005.
2. S.M.Ross, A first course in probability, Englewood cliffs Prentice Hall-NJ, 2002.
3. J.Cox and M.Rubinstein, Options Market, Englewood cliffs Prentice Hall-NJ, 2012.
4. J.E.Ingersill, Theory of financial decision making, Lanjarn, MD Rowerman of Little fields, 1987.

SMTB3010	ACTUARIAL MATHEMATICS	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objective: To learn and gain the knowledge about the impact of economic and social conditions in the financial sector. Create awareness about the financial terminology and calculations in the policy designing.

UNIT I LIFE INSURANCE

9

Hrs

Introduction to life insurance - Insurance Payable at the Moment of Death- Insurance Payable at the End of Year of Death - Relationship between Insurance Payable at the Moment of Death and End of the Year of Death.

UNIT II LIFE ANNUITIES

9

Hrs

Introduction to Life Annuities - Continuous Life Annuities - Discrete Life Annuities - Life Annuities with monthly Payments - Complete Annuities-Immediate and Apportion able Annuities-Due.

UNIT III GENERAL INSURANCE FOR BUSINESS

9

Hrs

Describe the general insurance business environment Current business environment - Main provider of general insurance - Main types of general insurance Purposes - Benefits and perils- Exposure to which premiums are related - Claim characteristics - Risk factors and risk rating

UNIT IV OCCUPATIONAL PENSION PROVISION

9

Hrs

Occupational pensions scheme – main features, advantages and disadvantages, occupational pension scheme and personal pension - Defined benefit occupational pension schemes (state provisions, advantages and disadvantages)

UNIT V BONDS AND OTHER SECURITIES

9

Hrs

Premium and Discount - Valuation between Coupon Payment Dates - Determination of Yield Rates - Callable and Puttable Bonds - Serial Bonds.

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

CO1	Demonstrate an appropriate mastery of theory and techniques
CO2	Identify appropriate techniques based on theory and practice in Annuities.
CO3	Apply general insurance policy in business environment and exposure main types of general insurance
CO4	Analyze the benefits of occupational pension
CO5	Evaluate the quantitative data in premium and securities and performing calculations
CO6	Create a data sheet for bonds and securities

TEXT BOOKS/REFERENCES:

1. Neelam C Gulati “Principles of Insurance Management”, Excel Books, New Delhi.
2. Harriett E Jones “Principles of Insurance “FLMI Insurance Education Program. Life Management Institute LOMA, (Dec 1995).
3. Micheal MParmenter, ‘theory of Interest and Life contingencies with Pension”, 3rd Edition.
4. Gerber, Hans U. – “Life insurance mathematics”3rd Edition – Springer. Swiss Association of Actuaries, 1997.
5. Chandra, P., Investment Analysis and Portfolio Management, 4th Edition, Tata McGraw-Hill

Education, New Delhi, 2012.

6. Ranganathan, M. and Madhumathi, R., Security Analysis and Portfolio Management, 2nd Edition, Pearson, New Delhi, 2012.
7. Gupta P. K., Insurance and risk management, HPH, 2nd edition, 2018.

Skill Development

SMTB1104	CALCULUS	L	T	P	Credit	Total Marks
		3	1	0	4	100

Course Objectives: Core concepts of calculus are derivatives and integrals. Knowledge and the ability to work with these concepts are essential for future studies of mathematical subjects and applications of mathematical techniques in other sciences. This study enables the students on understanding calculus concepts, analytical reasoning and developing crucial skills in order to calculate, analyze, interpret and communicate the results clearly.

UNIT I DIFFERENTIAL CALCULUS 10

Hrs

Successive differentiation Leibnitz's theorem (Without proof) and its application - Subtangent and Subnormal - Polar coordinates - Angle between the radius vector and tangent - Slope of the tangent - Angle between two curves - Polar sub tangent and Polar subnormal - Length of an arc.

UNIT II DIFFERENTIAL CALCULUS (CONTD...) 10

Hrs

Curvature - Radius of curvature in Cartesian and Polar co-ordinates, Centre of curvature and Circle of curvature - Evolutes and Envelopes - definition - Method of finding envelopes - Problems in all sections.

UNIT III MULTIVARIABLE CALCULUS 10

Hrs

Continuity and differentiability of a function of two and three variables - Taylor's theorem and Expansion of functions of two variables - Total differential - Jacobians - Maxima and minima of functions of two independent variables, Lagrange's multiplier method (without proof), problems on this concept.

UNIT IV INTEGRAL CALCULUS 10

Hrs

Integration - Bernoulli's formula - Definite Integrals and their properties- Reduction Formulae for $\sin^n x$, $\cos^n x$, $\tan^n x$, $\cot^n x$, $\sec^n x$, $\operatorname{cosec}^n x$, $\sin^m x \cos^n x$, $x^n e^{ax}$, $x^m (\log x)^n$ - Problems for all the above cases.

UNIT V MULTIPLE INTEGRALS 10

Hrs

Double Integrals - Change of order of Integration - Triple Integrals - Applications to Area, Surface Area and Volume (Simple problems).

TEXT / REFERENCE BOOKS

1. Narayanan. S, Manicavachagam Pillay. T.K. Calculus, S. Viswanathan (Printers and Publishers), 2006.
2. S. Arumugam, A.T. Issac, Calculus, New Gamma Publications, Revised Edition, 2011.
3. Dipak Chatterjee, Integral Calculus and differential equations, TATA McGraw S Hill Publishing Company Ltd., 2000.

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

CO1	Identify the region in change of order of integration. Recognize the parametric form of curves, derivatives and integrals of functions.
CO2	Explain the applications of double and triple integrals, applications of Leibnitz theorem.
CO3	Apply partial derivatives in Jacobians, Taylor's series and total differentiations.
CO4	Compare the changes in order of integration, compare the slope, normal and tangents in polar form.
CO5	Evaluate definite integrals using properties. Evaluate circle of curvature, Evolutes and Envelopes of given curves. Appraise the maxima and minima of multivariable functions.
CO6	Develop the concept of area, surface area & volume integrals in different engineering problems, Formulate the reduction formula to trigonometric and other functions.

SMTB1306	TRIGONOMETRY & 2D ANALYTICAL GEOMETRY	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objective: This course enables to evaluate trigonometric and inverse trigonometric functions. 6. Solve trigonometric equations and applications. To apply and prove trigonometric identities. To study the applications of conics, asymptotes.

UNIT I EXPANSIONS AND HYPERBOLIC FUNCTIONS

9

Hrs

Expansions of $\cos \theta$, $\sin \theta$ in powers of $\sin \theta$ and $\cos \theta$ - Expansion of $\tan \theta$ in powers of $\tan \theta$ - Powers of sines and cosines of θ in terms of functions of multiples of θ - Expansions of $\sin \theta$ and $\cos \theta$ in a series of ascending powers of θ - Evaluation of limits - Hyperbolic functions - Relations between hyperbolic functions - Inverse hyperbolic functions - problems.

UNIT II SUMMATION OF TRIGONOMETRIC SERIES

10 Hrs

Logarithm of a complex number - Summation of trigonometrical series by the method of differences - Sum of series of n angles in A.P. - Summation of series using C+iS form - Gregory's series - Euler's series.

UNIT III CONIC

11

Hrs

Geometric definition of Conic – the focus, directrix and eccentricity of a Conic. Classification of Conic into Ellipse, Parabola and Hyperbola based on the value of eccentricity. Parametric representation of Conics in standard form. Condition for a given straight line to be tangent to a Conic. Parabola - Equation of the tangent and normal to the parabola - Ellipse - Equation of the tangent and normal to the ellipse - conjugate diameters - Hyperbola - Equation of the tangent and normal to the hyperbola.

UNIT IV ASYMPTOTES

9

Hrs

Asymptotes - Conjugate hyperbola - Conjugate diameters - Rectangular hyperbola - Equation of the tangent and normal to the rectangular hyperbola.

UNIT V POLAR EQUATION

11 Hrs

Polar equation of a conic - Equation of the tangent and normal to the conic $l/r = 1 + e \cos \theta$ whose vectorial angle is α - Equation of asymptotes to the conic $l/r = 1 + e \cos \theta$ - Equation of polar to the conic $l/r = 1 + e \cos \theta$

TEXT / REFERENCE BOOKS

1. Narayanan. S, Manicavachagom Pillay. T.K, Trigonometry, S. Viswanathan (Printers and Publishers), 1980.
2. S. Arumugam & Others, Trigonometry, New Gamma Publications, Revised Edition, 1985.
3. Manicavachagom Pillay, Natarajan, A Text book of Analytical Geometry (Part I-Two Dimensions), S. Viswanathan (Printers and Publishers), 1981.
4. A. Singaravelu, Algebra and Trigonometry, Vol – I & II Meenakshi Agency, Chennai, 2003.

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

CO1	List the formula of $\sin \theta$ and $\cos \theta$ in a series of ascending powers of θ . Identify the relations between hyperbolic functions and different forms of conics.
CO2	Explain the methods of Expansions of trigonometric functions in powers of $\sin \theta$, $\cos \theta$ and $\tan \theta$. Summarize the trigonometric series by the various methods.
CO3	Choose the series formula and expand the trigonometric functions in a series of ascending powers of θ . Solve the problems on inverse hyperbolic functions and problems on equations of polar to conics.
CO4	Classification of Conics. Compare the tangent and normal equations of standard conics.
CO5	Evaluate the problems in Asymptotes, Conjugate hyperbola and diameters.
CO6	Create the polar equation of a conic

Skill Development

SMTB1205	THEORY OF EQUATIONS & MATRICES	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objective: This course enables the student to learn to solve systems of linear equations and application problems requiring them. Helps to find and use eigen values and eigen vectors of a matrix and to work with matrices and determine if a given square matrix is invertible

UNIT I THEORY OF EQUATIONS**10 Hrs**

Polynomial equations – Imaginary and Irrational roots – relation between roots and coefficients of equations – Symmetric functions of roots in terms of coefficients of third-degree equation -problems.

UNIT II RECIPROCAL EQUATIONS**10 Hrs**

Sum of the powers of the roots of an equation – Newton's Theorem on the sum of the powers of the roots – Transformation of equations – Roots with sign changed – Roots multiplied by a given number – Reciprocal equations – problems.

UNIT III TRANSFORMATION OF EQUATIONS**10 Hrs**

Increase or decrease the roots of a given equation by a given quantity. Removal of terms - Square of the roots – Transformations in general – Descartes' rule of signs – problems.

UNIT IV ELEMENTARY CONCEPTS**10 Hrs**

Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal and unitary matrices, Triangular and diagonal matrices, Rank of a matrix, Elementary transformations, Echelon and normal forms, Inverse of a matrix by elementary transformations.

UNIT V MATRICES

10 Hrs Characteristic equation, Eigen values and Eigen vectors of a matrix, Cayley-Hamilton's theorem and its use in finding inverse of a matrix, Application of matrices to solve a system of linear (both homogeneous and non-homogeneous) equations, Consistency and general solution, Diagonalization of square matrices with distinct Eigen values, Quadratic forms.

TEXT / REFERENCE BOOKS

1. T. K. Manickavasagam Pillai, Natarajan and Ganapathy, Algebra, Volume II, S.Viswanathan Pvt. Ltd., 2004.
2. T.K.Manickavachagam Pillai, Matrices, S.Viswanathan Printers & Publishers, 2012.
3. S. Sudha, Algebra, Analytical Geometry (2D) and Trigonometry, Emerald publishers, 1998.
4. A. Singaravelu, Algebra & Trigonometry, Vol. I & II, Meenakshi Agency, 2003.

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

CO1	List the imaginary and irrational roots of polynomial equations. Identify the nature of roots by Descartes's rules and quadratic forms. Recall types of matrices.
CO2	Understand the relations between roots and coefficients of equations. Sum the powers of roots of an equation by different methods.
CO3	Choose appropriate method and solve the reciprocal equations. Apply the concept of diminishing and produce the new equation. Solve by removing terms of polynomial equations. Uses of Cayley-Hamilton theorem.
CO4	Distinguish Echelon and normal forms in matrices.
CO5	Evaluate rank and inverse of matrices by elementary transformations.
CO6	Construct the diagonal matrix by transformations.

SMTB1404	3D ANALYTICAL GEOMETRY & VECTOR CALCULUS	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objective: To understand the concepts of 3-dimensional analytical geometry and finding shortest distance between skew line and orthogonal spheres. To analyse the differentiation and integration with vectors.

UNIT I RECTANGULAR**CARTESIAN****CO-ORDINATES**

10 Hrs

Direction cosines of a line – Direction ratios of the join of two points - Projection on a line – Angle between the lines -Equation of a plane in different forms - Intercept form- normal form - Angle between two planes - Planes bisecting the angle between two planes, bisector planes.

UNIT II PLANE AND STRAIGHT LINE

10 Hrs

Equation of a line in different forms - reduction to symmetric form of a given line - angle between the lines - image of a point and a line with respect to a plane- plane and a line- Angle between a line and a Plane - Co-Planarity of two lines –Skew lines-Shortest distance between two skew lines.

UNIT III SPHERE

10 Hrs

Equation of the sphere - general form - plane section of a sphere- tangent line and tangent plane – orthogonal spheres.

Skill Development

UNIT IV VECTOR DIFFERENTIATION**10 Hrs**

Limit of a vector function – Continuity of vector functions – Derivative of a vector function — Scalar and vector point functions – Gradient of a scalar point function – Directional derivative of a scalar point function – Divergence and curl of a vector point function – Solenoidal vector – Irrotational vector – Vector identities.

UNIT V VECTOR INTEGRATION**10 Hrs**

Vector integration – Line integral – Application of line integral. Surface and Volume integrals – Applications - Gauss Divergence theorem. Stoke's theorem – Green's theorem.

TEXT / REFERENCE BOOKS

1. P. R. Vittal and V. Malini, Vector Analysis, Margham Publications, Chennai, 2006.
2. T. K. Manickavasagam Pillay and others, Vector Calculus, S. Viswanathan Publications.
3. S. Shanti Narayan, A Text Book of Vector Calculus, S. Chand and Co., New Delhi, 1966.
4. K. Viswanathan & S. Selvaraj, Vector Analysis, Emerald Publishers, Chennai, Reprint 1999.
5. P. Duraipandian, Laxmi Duraipandian, Vector Analysis, Emerald Publishers, Chennai, Reprint 2003.
6. Shanthi Narayanan and Mittal P. K: Analytical Solid Geometry 16th Edition S.Chand & Co., New Delhi, 2006.
7. Analytical Geometry – 3D by T.K. Manickavasagam Pillay and others S. Viswanathan (Printers & publishers), Chennai, 2001.
8. N. Saran and R. S. Gupta, Analytical Geometry of 3D, Pothishala Pvt. Ltd., Allahabad.

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

CO1	Describe equation of a plane in different forms, define direction cosines and direction ratios of a line and find angle between two planes, Bisector planes.
CO2	Identify the angle between lines, angle between line and plane Intersection of two lines. Estimate shortest distance between two skew lines
CO3	Sketch the general form of sphere, Orthogonal sphere and plane section of a sphere.
CO4	Apply gradient to solve problems involving normal vectors to level surfaces.
CO5	Evaluate line integral, surface and volume integral.
CO6	Integrate surface and volume integrals using Gauss Divergence, Stokes and Greens theorem.

 Skill Development

SMTB1305	ORDINARY & PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objective: This course enables to evaluate first order differential equations including separable, homogeneous, exact, and linear, existence and uniqueness of solutions. Solving second order and higher order linear differential equations. Introducing partial differential equations and to solve second and higher order Partial Differential with different methods.

UNIT I DIFFERENTIAL EQUATIONS OF FIRST ORDER

10 Hrs

Elementary Methods in Ordinary Differential Equations. Formation of differential equation. Solutions: General, particular, and singular. First order exact equations and integrating factors. Degree and order of a differential equation. Equations of first order and first degree. Equations in which the variable are separable. Homogeneous equations. First order higher degree equations solvable for x, y, p. Clairaut's form and singular solutions. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations.

UNIT II DIFFERENTIAL EQUATIONS OF SECOND ORDER

10 Hrs

Linear differential equations of second order. Second order equation with constant coefficient with particular integrals for e^{ax} , x^m , $e^{ax}\sin mx$, $e^{ax}\cos mx$. Method of variation of parameters. Ordinary simultaneous differential equations.

UNIT III PARTIAL DIFFERENTIAL EQUATION

10 Hrs

Partial differential equations. Formation of partial differential equations. Types of solutions. PDEs of the first order. Lagrange's solution.

UNIT IV PARTIAL DIFFERENTIAL EQUATION (CONTD...)

10 Hrs

Some special types of equations which can be solved easily by methods other than the general methods. Charit's and Jacobi's general method of solution.

UNIT V SECOND AND HIGHER ORDER PARTIAL DIFFERENTIAL EQUATION

10 Hrs

Partial differential equations of second and higher order. Classification of linear partial differential equations of second order. Homogeneous and non-homogeneous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficients.

TEXT / REFERENCE BOOKS

1. P. Kandasamy, K. Thilagavathy, Mathematics for B. Sc Branch –I, Volume 3, 1st Edition, S. Chand and Co.Ltd., New Delhi, 2004.
2. M. K. Venkataraman and S. Krishnan, Engineering Mathematics, The National Publishing Co., 2010.
3. Dipak Chatterjee, Integral Calculus and differential equations, TATA McGraw S Hill Publishing Company Ltd., 2000.
4. Narayanan, T.K. Manichavasagam Pillai, Calculus, Vol. I, S. Viswanathan Printers Pvt. Limited, 2007.
5. Dr. S. Sudha, Differential Equations & Integral Transforms, Emerald Publishers, 2002.

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

CO1	Define Order, degree of ODE and PDE. Identify the methods to solve homogeneous and non-homogeneous ODE and PDE.
CO2	Classify ODE and PDE. Illustrate various methods to solve second order Differential equation and Partial differential equations.
CO3	Solve some special types of partial differential equations by Charpit's and Jacobi's method.

CO4	Analyze the solution of first order differential equations by various methods.
CO5	Evaluate higher order differential equations by method of variation of parameters.
CO6	Formation of ODE & PDE for the given function.

Skill Development

SMTB3002	TRANSFORM TECHNIQUES	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objective: This course gives opportunity to students to know the principles and concepts of Laplace Transforms, Fourier Transforms and Z-Transforms. Apply Laplace Transform to solve differential equations. Evaluate integrals using Laplace Transform and Fourier Transform. Formation of difference equations and make use of the concepts of Z-Transforms to solve the difference equations.

UNIT I LAPLACE TRANSFORM

10

Hrs

Laplace transform – Transforms of standard functions – properties– Transforms of derivatives and integrals – Transforms of the type $e^{at}f(t)$, $tf(t)$, $f(t)/t$ - Transform of periodic functions – Transform of unit step function and impulse function - Initial and final value theorems

UNIT II INVERSE LAPLACE TRANSFORM

10

Hrs

Inverse Laplace transform – Transforms of standard functions – properties - Convolution theorem – Heaviside expansion theorem and its application.

UNIT III APPLICATIONS OF LAPLACE TRANSFORM

8

Hrs

Linear ordinary differential equation with constant co-efficient – Integral equations - Integral equations of convolution type - simultaneous linear differential equations with constant co-efficient

UNIT IV FOURIER TRANSFORM

11

Hrs

The infinite Fourier transform – Sine and Cosine transform – Properties – Inversion theorem – Convolution theorem – Parseval's identity – Finite Fourier sine and cosine transform.

UNIT IV Z TRANSFORM

11

Hrs

Z-transform and inverse Z-transform of elementary functions, shifting theorems, Convolution theorem, Initial and final value theorem, Application of Z-transforms to solve difference equations.

TEXT/ REFERENCE BOOKS

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2011.
2. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, Narosa Publishing House, 2009.
3. F. B. Hildebrand, Methods of Applied Mathematics, Courier Dover Publications, 1992.
4. L. Debanth and D. Bhatta, Integral Transforms and Their Applications, 2nd Ed., Taylor and Francis Group, 2007

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

CO1	Applying the concept of Laplace Transforms to various type of functions.
CO2	Illustrate the solution for the functions using inverse Laplace transforms.
CO3	Produce the solution for integral and differential equations using Laplace and inverse Laplace Transforms.
CO4	Evaluate the functions by using finite and infinite Fourier transforms.
CO5	Implement the solution for various functions using z transforms and Inverse Z transforms.
CO6	Determine the solution of difference equations using z transforms and Inverse Z transforms.

Skill Development

SMTB1405	FOURIER SERIES & APPLICATION OF DIFFERENTIAL EQUATION	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objective: This course provides students to get exposed to the concepts of Fourier series. Know the Application of Differential Equations. Apply Fourier series in solving Partial Differential Equations.

UNIT I FOURIER SERIES

9 Hrs

Definition- Dirichlets conditions- coefficients- Fourier series for the function defined in $[c, c+2\pi], [c, c+2l]$ – odd and even functions in fourier series- Parseval's identity (without proof).

UNIT II FOURIER SINE AND COSINE SERIES

9 Hrs

Half range cosine series and sine series of $f(x)$ defined in $[0, \pi], [0, l]$ - Parseval's Identity (without proof) - simple problems – Complex form of Fourier series-Harmonic Analysis.

UNIT III APPLICATION OF ODE

9 Hrs

Particle dynamics: Simple Harmonic motion – Projectiles: – horizontal plane - trajectory – velocity of projection – angle of projection – Range - time of flight – greatest height - projectiles on inclined plane. Central orbit and Central forces: – differential equation of a path – pedal equation of a differential equation – velocity at any point of a central orbit – areal velocity – Kepler's laws of planetary motion.

UNIT IV APPLICATION OF PDE

9 Hrs

One dimensional wave equation – Transverse vibration of finite elastic string with fixed ends – boundary and initial value problems – Fourier series solution – one dimensional heat equation – steady and unsteady state – boundary and initial value problems – Fourier series solution.

UNIT V APPLICATION OF PDE

9 Hrs

Two-dimensional heat equation - steady state heat flow in two dimensions- Laplace equation in Cartesian and polar co-ordinates (excluding annulus) – Fourier series solution.

TEXT /REFERENCESBOOK

1. George F Simmons, Differential equation with Applications and historical notes, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
2. S Narayanan & T K Manicavachogam Pillay, Differential Equations.: S V Publishers Private Ltd., 1981.
3. G K Ranganath, Text book of B.Sc, Mathematics, Revised ed. New Delhi, India: S Chand and Company Ltd., 2011.
4. Frank Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA: McGraw-Hill, 1972.
5. S Narayanan, Dynamics, 16th ed. New Delhi: S Chand and Company Ltd., 1986.
6. N.P. Bali, Dynamics (Golden Series), Latest ed. New Delhi, India: Lakshmi Publications (p) Limited, 2004.

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

CO1	List the periods for trigonometric functions. Identify even and odd functions. Recall integration formulas.
CO2	Understand and classify half range cosine and sine series
CO3	Apply methods to solve Kepler's law of planetary motion, pedal equation of a differential equation
CO4	Distinguish ordinary differential equation and partial differential equation
CO5	Evaluate one dimensional heat equation with boundary and initial value condition. Discriminate between steady and unsteady state problems
CO6	Formulate two-dimensional heat equation for Cartesian and polar coordinates.

SMTB1406	NUMERICAL METHODS	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objective: To acquire knowledge in the field of numerical analysis and also design and analyze the techniques to give approximate and accurate solutions to numerical problems

UNIT I DIRECT AND ITERATIVE METHODS 9

Hrs

Direct Method: Gauss elimination method – Error Analysis– Iterative methods: Gauss- Jacobi and Gauss-Seidel – Convergence considerations – Eigen value Problem: Power method.

UNIT I NUMERICAL DIFFERENTIATION AND INEGRATION 9

Hrs

Interpolation: Lagrange's and Newton's interpolation -- Errors in interpolation – Optimal points for interpolation - Numerical differentiation by finite differences – Numerical Integration: Trapezoidal, Simpson's and Gaussian quadrature – Error in quadrature.

UNIT II POLYNOMIAL APPROXIMATION 9

Hrs

Norms of functions – Best Approximations: Least squares polynomial approximation – Approximation with Chebyshev polynomials – Piecewise Linear & Cubic Spline approximation.

UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9

Hrs

Single-Step methods: Euler's method –Taylor series method – Runge-Kutta method of fourth order – Multistep methods: Adams-Bashforth and Milne's methods – Stability considerations – Linear Two point BVPs: Finite Difference method.

UNIT V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATION 9

Hrs

Elliptic equations: Five-point finite difference formula in rectangular region – truncation error; One-dimensional Parabolic equation: Explicit and Crank-Nicholson schemes; Stability of the above schemes - One-dimensional Hyperbolic equation: Explicit scheme.

TEXT / REFERENCE BOOKS

- 1 Kandasamy P, Thilagavathy. K and G. Gunawathy, Numerical Methods, S.Chand & Sons, 3rd Revised Edition, 2013.
- 2 Balagurusamy. E, Numerical Methods, Tata Mcgraw Hill Publishing Company, 3rd Edition, 2000.
- 3 Isaacson E. and Keller, H.B., "Analysis of Numerical Methods" Dover Publication, 1994.
- 4 Philips G.M and Taylor P.J., "Theory and Applications of Numerical Analysis", Academic Press, 1996.
- 5 Jain M.K, "Numerical Methods for Scientific and Engineering computation", 3rd Edition, New Age International, 1999.
- 6 Conte S.D. and Carl de Boor, "Elementary Numerical Analysis", 3rd Edition, Tata McGraw-Hill Publishing Company. 2004.
- 7 Atkinson K.E., "An Introduction to Numerical Analysis", Wiley & Sons, 2nd Edition, 1989.

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

CO1	List the types of direct method and iterative methods. State the difference between the Gauss–Seidel and Jacobi methods.
CO2	Classify the concepts of numerical differentiation and numerical integration.
CO3	Solve the polynomials using Chebyshev method.
CO4	Discriminate between single step methods and multistep methods.
CO5	Determine the temperature for parabolic equations for various x values
CO6	Develop the temperature table for parabolic equation for suitable formulas

SMTB4003	MECHANICS	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

Course Objectives: To understand the procedures for analysis of static objects and also analyses and design the construction of force and moments in two and three dimensions.

UNIT I **STATICS**

10 Hrs

Forces acting on a Particle – Concurrent forces – Equilibrium of forces acting at a point – **Parallelogram Law of forces – Triangle Law of forces - Lami's theorem** – Polygon of forces

UNIT II **PRINCIPLES OF MOMENTUM**

10

Hrs

Moment of a force about a point and a line – Theorems on moments- resultant of like and unlike parallel forces – couples- reduction of a force and couple in a plane to a single force – **laws of friction-Equilibrium of a particle on a rough inclined plane.**

UNIT III **KINEMATICS**

10

Hrs

Kinematics – motion of a point – **Velocity and acceleration** – Composition of velocities – Relative velocity – Motion in a straight line under uniform acceleration and variable acceleration – **Vertical motion under gravity**

UNIT IV **NEWTON'S LAW OF MOTION**

10

Hrs

Newton's laws of motion – conservation of linear momentum – motion of a particle on a rough horizontal and inclined plane under the action of a constant force – Motion in a resisting medium with resistance varying as velocity and velocity².

UNIT V **PROJECTILES**

10

Hrs

Projectiles – Trajectory – ranges on horizontal and inclined planes – enveloping parabola - impact of elastic bodies – **impact of two smooth spheres (direct and oblique) – loss of kinetic energy.**

TEXT / REFERENCE BOOKS

1. Naik, K.V. and Kasi, M.S., Statics and dynamics, Emerald publishers, 1992.
2. Narayanan, S., Statics and Dynamics Rochouse & Sons Pvt., Ltd
3. Venkataraman, M.K., Statics and Dynamics, 1982.

4. . P.Duraipandian and Laxmi Duraipandian, Mechanics, S. Chand and Company Ltd. 1985.

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

CO1	Identify Parallelogram law of force, Triangle law of force and Concurrent forces.
CO2	Discuss moment of force about a point and a line. Summarize law of friction.
CO3	Calculate velocity and acceleration, Motion in a straight line under uniform and variable acceleration.
CO4	Categorize the motion of a particle on a rough horizontal and inclined plane by Newton's law of motion.
CO5	Estimate the impact of elastic bodies and two smooth spheres.
CO6	Create envelope of Projectile Trajectories

Skill Development

SMTB2301	SPSS Lab	L	T	P	CREDITS	TOTAL MARKS
		0	0	2	2	100

Course Objectives

1. To reinforce the basic skills to organize, manage and present data using SPSS.
2. To impart to the students the knowledge of doing statistical data analysis and to demonstrate graphically using frequency distributions and cumulative frequency distributions.

S.No.	Exp. No	Name of experiments	Duration
1.	1	Creation of SPSS data file	2
2.	2	Frequency Analysis- preparation of charts and diagrams	2
3.	3	Descriptive Statistics	2
4.		Extended experiment – 1	2
5.	4	Parametric Test – One sample t-test	2
6.	5	Parametric Test – Independent t-test	2
7.	6	Parametric Test – Paired t-test	2
8.		Extended experiment -2	2
9.	7	Non-parametric Test- Chi-square test	2
10.	8	Non-parametric Test - Mann Whitney test	2

11.	9	Non-parametric Test - Kruskal Wallis test	2
12.		Extended experiment – 3	2
13.	10	Correlation-Bivariate	2
14.	11	Rank Correlation	2
15.	12	Regression	2
16.		Extended experiment -4	2

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 Spread sheet, Tata McGraw Hill, 2009.
4. Wayne L. Winston, Microsoft Excel 2010, Data Analysis & Business Modeling, 3rdedition, 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 Outcomes: At the end of the course, the student will be able to:

CO1	Discuss the concepts in Data Analysis and create data files using SPSS. Compute measures of association and structural models for discrete data
CO2	Preparation of Charts and Tables for frequency distributions using SPSS. Visualize categorical data and conduct explorative data analysis.
CO3	Compute the parametric tests for real world problems. Conduct inference for model parameters.
CO4	Compute the Non-parametric tests for real world problems Check model assumptions and analyse residuals and goodness-of-fit.
CO5	Evaluate Bivariate Correlation Coefficient using Karl Pearson and Spearman.
CO6	Apply Multiple Regression analysis technique for real life problems and predict the future values

SMTB2401	MATLAB for NUMERICAL METHODS	L	T	P	CREDITS	TOTAL MARKS
		0	0	3	2	100

Course Objective: To Impart the Knowledge to the students with MATLAB software. To provide a working introduction to the Matlab technical computing environment.

List of Experiments

1 Introduction to MATLAB

2.Study of Vector and Matrix Operations

3.Solution of System of equations

a. Gauss Elimination method

b. Gauss Seidel method

4.Numerical Differentiation

5.Numerical Integration

a. Trapezoidal

b. Simpsons rule

6. Least square polynomial approximation

7. Solution of ODE

a. Taylors series method

b. Euler's method

c. Runge Kutta method of fourth order

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

CO1	Describing programs to solve engineering problems
CO2	Implementing the concepts, principles in Least square polynomial approximation
CO3	Solve Numerical differentiation and Numerical Integration problems using Matlab
CO4	Discriminate between Gauss seidal and gauss elimination methods.
C05	Determine the solution of ODE using Taylor series, Eulers and Runge kutta methods
CO6	Develop the program using suitable formulas

 Skill Development

SMTB3007	CRYPTOGRAPHY	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

Course Objectives: This course facilitate the students to improve knowledge and skills of standard concepts in cryptography and exhibits how cryptography plays an significant role in the present digital world by knowing encryption and decryption techniques and secure data in transit across data networks.

Unit I Introduction to Number Theory

9 Hrs

Finite Fields and Number Theory: Modular arithmetic, Euclidian Algorithm, Primality Testing: Fermat's and Eulers theorem, Chinese Remainder theorem, Discrete Logarithms

Unit II Cryptography and its Techniques

9 Hrs

Overview of Cryptography, Computer security concepts, Security attacks, Symmetric cipher model, Cryptanalysis and brute-force attack, Substitution techniques, Caesar cipher, Mono alphabetic ciphers, Play fair cipher, Hill cipher, Poly alphabetic ciphers, One-time pad, Transposition techniques, Binary and ASCII.

Unit III Data Encryption Standard (DES) and Advanced Encryption Standard (AES)

9 Hrs

Pseudo-random bit generation, Stream ciphers and Block ciphers and the Feistel cipher, The data encryption standard (DES), DES example, advanced encryption standard (AES), AES transformation functions, AES key expansion, AES example.

Unit IV Public-key Cryptography

9

Hrs

Principles of public-key cryptosystems, The RSA algorithm and security of RSA, Elliptic curve arithmetic, Elliptic curve cryptography, Cryptographic Hash functions, Secure Hash algorithm, Message Authentication, Message Authentication Code (MAC).

Unit V Digital Signatures and Network Security

9 Hrs

Digital signatures, Elgamal and Schnorr digital signature schemes, Digital signature algorithm. Wireless network and mobile device security, Email architecture, formats, threats and security, Secure/Multipurpose Internet Mail Extension (S/MIME) and Pretty Good Privacy (PGP).

References

1. Stallings, William (2017). Cryptography and Network Security, Principles and Practice (7th ed.). Pearson Education Limited. England.
2. Trappe, Wade & Washington, Lawrence C. (2006). Introduction to Cryptography with Coding Theory (2nd ed.). Pearson Education International.
3. Stinson, Douglas R. (2005). Cryptography Theory and Practice (3rd ed.). CRC Press.
4. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India.
5. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata Mc Graw hill, India.

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

CO1	Understand the fundamentals of Cryptography including data and advanced encryption standard (DES & AES), RSA and elliptic curve cryptography.
CO2	Classify Encryption and decryption messages using block ciphers, sign and verify messages using well known signature generation and verification algorithms.
CO3	Identifying Authentication functions, the manner in which Message Authentication Codes and Hash Functions works.
CO4	Analyze Key Management techniques and importance of number Theory.
CO5	Developing knowledge of standard algorithms that can be used to provide confidentiality, integrity and authentication of data.
CO6	Design a security solution for a given application.

SMTB1204	SEQUENCE AND SERIES	L	T	P	EL	C
		3	1	0	0	4

COURSE OBJECTIVES:

- To understand the basic definitions of limits and convergence in the context of sequences and series of real numbers.
- To provide the limits of sequences involving elementary functions by applying Cauchy's test D Alembert's test Raabe's test

UNIT I SEQUENCES**12 Hrs**

Sequence-Limit, Convergence of a sequence- Cauchy's general principle of convergence Cauchy's first theorem on Limits-Bounded sequences – Divergent and Oscillating Sequence.

UNIT II LIMIT OF THE SEQUENCE**12 Hrs**

Behavior of monotonic sequence – finite or infinite Sequence- Limit superior and Limit inferior -Some theorems on limits and Problems.

UNIT III INFINITE SERIES**12 Hrs**

Infinite series - Definition of Convergence, Divergence & Oscillation Series – Necessary condition for convergence –Convergence of Geometric series-Exponential & Logarithmic series –Summation of Series & Approximations using these theorems.

UNIT IV TESTING OF SERIES-I**12 Hrs**

Testing the convergence and divergence of series using Comparison test -D,,Alembert's ratio test- Raabe's test and Leibnitz's Test with simple problems.

UNIT V TESTING OF SERIES-II**12Hrs**

Testing of series to obtain the convergence and divergence using Cauchy's condensation Test- Cauchy's root test and their simple problems- Alternative series with simple problems.

Max. Hrs: 60 Hrs

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

- CO1 Discuss the convergence of sequence
- CO2 Evaluate the limits of finite and infinite sequence
- CO3 Compute the convergence and summation of infinite series
- CO4 Test the convergence of series using comparison, D'Alembert's ratio test, Raabe's Test and Leibnitz's test
- CO5 Investigate the convergence of series using Cauchy's Condensation Test and Cauchy's root test
- CO6 Explore convergence and divergence of Alternating series

TEXT / REFERENCESBOOK

1. T.K. Manicavachagam Pillai, T. Natarajan, K.S. Ganapathy, , Vol. I, S. Viswanathan Pvt Limited, Chennai, 2004.
2. M.K.Singal&Asha Rani Singal, A first course in Real Analysis, R. Chand & Co. 1999.
3. Dr.S.Arumugam, Sequences & Series, New Gamma Publishers, 1999

MSc., Mathematics

SMTB7002	FUZZY ANALYSIS	L	T	P	CREDIT
		3	0	0	3

Course Objective: To introduce the basic concepts of fuzzy sets, fuzzy arithmetic and relations. The concepts of fuzzy sets are introduced and their role in applications of optimization and decision making, Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

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

Fuzzy set: Basic types and Basic concepts – Fuzzy sets Versus Crisp sets: Extension Principle for fuzzy sets – Operations on Fuzzy sets: 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**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

SMTB5106	STATISTICAL INFERENCE AND STOCHASTIC PROCESS	L	T	P	CREDIT
		3	1	0	3

Course Objective: This course will cover probability, parametric, Non parametric test and basic of stochastic processes. To study the real life experiments using ANOVA (design of experiment), Markov chain, Poisson process and its variations. To determine the higher order transition probabilities.

UNIT 1 THEORY OF ESTIMATION

9 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

9 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

9 Hrs

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 DESIGN OF EXPERIMENTS

9 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

9 Hrs

Specification of SP; Markov chain; transition probabilities; Determination of higher order transition probabilities; Chapman-Kolmogorov equation; Poisson processes (introduction only). **Max Hrs: 45 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 InterScience, 1990.

Employability

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 –Wolfowiz 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.					
SMTB5203	ADVANCED NUMERICAL METHODS	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVE:

- To Understand analytical, developmental and technical principles that relate to Numerical Linear Algebra
- To understand the Numerical Methods for solving Differential Equations
- To develop the academic abilities required to solve problems and applications in Numerical methods
-

UNIT I TRANSCENDAL AND POLYNOMIAL EQUATIONS**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 II SYSTEM OF EQUATIONS**9 Hrs**

The 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 III INTERPOLATION AND APPROXIMATION**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 IV DIFFERENTIATION AND INTEGERATION**9 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

 Employability

UNIT V ORDINARY DIFFERENTIAL EQUATIONS

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

REFERENCE BOOKS:

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Fourth Edition. 2007
2. Samuel.D.Conte and Carl DeBoor, Elementary Numerical Analysis, Revised Third Edition, 1972
3. F.B.Hildebr, Introduction to Numerical Analysis, TMH, 1991.

COURSE OUTCOME: 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

 Employability

SMTB7004	FUZZY SETS , LOGIC THEORY AND APPLICATION	L	T	P	EL	C
		3	1	0	0	4

Course Objectives:

- To introduce the theory of fuzzy sets.
- To discuss theoretical differences between fuzzy sets and classical sets.
- To discuss fuzzy logic inference
- To introduce fuzzy arithmetic concepts
- To discuss fuzzy inference applications in the area of control.

UNIT I FUZZY SET**12 Hrs**

Classical sets: Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets.

UNITII FUNDAMENTALS OF FUZZY LOGIC**12 Hrs**

Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.

UNITIII FUZZIFICATION AND DEFUZZIFICATION**12 Hrs**

Features of the membership functions, various forms, Fuzzification, Defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation..

UNITIV FUZZY SYSTEMS**12 Hrs**

Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories

UNIT V FUZZY CLASSIFICATION**12 Hrs**

Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition

Max. Hrs: 60 Hrs

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

CO1	Interpret Fuzzy Set Theory And Uncertainty Concepts
CO2	Identify The Similarities And Differences Between Probability Theory
CO3	Fuzzy Set Theory And their Application Conditions
CO4	Apply Fuzzy Set Theory In Modeling And Analyzing Uncertainty In A Decision Problem
CO5	Apply Fuzzy Control By Examining Simple Control Problem Examples
CO6	Evaluate The Fuzzy Classification Problems With Examples

 Employability

SMTB7001	ADVANCED DATA ANALYTICS	L	T	P	CREDIT
		3	0	0	3

Course Objective: The objective is to enable the students to learn, understand and practice R, which include the study of data standardization, Z score, probability distribution, focusing on time series by understanding through real-world statistical applications. Then Identify an appropriate probability distribution for a given discrete or continuous random variable

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 I 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> Leland
7. 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	To identify the characteristics of datasets and compare the trivial data
CO2	To understand the concept of the probability distribution of a continuous random variable and how it is used to compute probabilities and to illustrate normally distributed random variables.
CO3	To examine how the changes associated with the chosen data point, compare to shift in other variables over the same period and future values of the time series variable.
CO4	To analyze a sequence of data points collected over an interval of time.
CO5	To evaluate all the information necessary to recreate the output, expression passed to it as argument.
CO6	To integrate mathematical and statistical tools with technologies

 Employability

SMTB5402	FLUID DYNAMICS	L	T	P	CREDIT
		3	1	0	4

Course Objective: Identify the fundamental kinematics of a fluid element. Prepare a foundation to understand the motion of fluid and develop concept, models and techniques. Study analytical solutions to variety of simplified problems, Apply the basic applied-mathematical tools that support fluid dynamics to solve the problems of fluid flow and help in advanced studies and research in the broad area of fluid motion.

UNIT 1 KINEMATICS

12 Hrs

Kinematics of fluids in motion: Real fluids and ideal fluids, velocity of a fluid at a point, streamlines and path lines, Steady and unsteady flows. The velocity potential, The vorticity vector, Local and particle rates of change, The equation of continuity, worked examples, acceleration of a point of a fluid.

UNIT 2 MOTION OF A FLUID

12 Hrs

Equations of motion of a fluid : pressure at a point in a fluid at rest, Pressure at a point in a moving fluid, Conditions at a boundary of two inviscid Immissible fluids, Euler's equations of motion, Bernoulli's equation, worked examples, Some flows involving axial symmetry, Some special two dimensional flows, Impulsive motion.

UNIT 3 TWO DIMENSIONAL FLOWS - I

12 Hrs

Some two dimensional flows: Meaning of two dimensional flows, use of cylindrical polar coordinates, The stream function. The complex potential for two-dimensional irrotational, incompressible flow, complex velocity potential for standard two-dimensional flows, uniform stream, line sources and line sinks, line doublets, line vortices, worked examples.

UNIT 4 TWO DIMENSIONAL FLOWS - II

12 Hrs

Some two dimensional flows(Continued): Two dimensional image systems, The Milne Thomson circle theorem, some application of the circle theorem, extension of the circle theorem, the theorem of blasius, The use of conformal transformation – some hydro dynamical aspects of conformal transformation worked example, vortex rows – single infinite rows of line vortices, The karman vortex street.

UNIT 5 THREE DIMENSIONAL FLOWS

12 Hrs

Some three dimensional flows: Introduction, sources, sinks and doublets, Images in a rigid infinite plane, Axi-symmetric flows, Stokes stream function, some special form of the stream function for axi-symmetric irrotational motions.

Max

Hrs: 60 Hrs

REFERENCE BOOKS

1. F.Chorlton, Textbook of Fluid Dynamics, CBS Publication and Distribution, 2004.
2. M.D. Raisinghania, Fluid Dynamics, S.Chand,2008.
3. G.K.Batchelor, An Introduction to Fluid Mechanics, Foundation Books,1984.

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

CO1	Define Real Fluids, Ideal Fluids, Streamlines, Pathlines, Vortex Lines, Source, Sinks, Doublets, Potential Flow, Irrotational Flow, 2D Flow, 3D Flow, Impulsive Motion
CO2	Derive Equation of Continuity, Euler's equation of motion, Bernoulli's equation, Milne Thomson Circle Theorem, Theorem of Blasius. Explain Axisymmetric flows, Karman Vortex Street.
CO3	Prepare Conditions at boundary of two inviscid Immiscible Fluid, Two Dimensional Image system. Application of Circle Theorem.
CO4	Analyze fluid motion in General. Discuss Steady & Unsteady Flow, Compressible & Incompressible Fluid, Viscous & Inviscid Fluid, Sources, sinks & doublets.
CO5	Evaluate the velocity potential, streamlines, pathlines, equi-potential surface, stream function, complex potential for two dimensional, irrotational, incompressible flow.
CO6	Determine the relation between local and particle rate of change, Develop Stokes stream function, Determine the flow characteristics, hydrodynamical aspects of Conformal transformation, pressure at a point in a fluid.



Skill Development

SMTB7003	ADVANCED GRAPH THEORY	L	T	P	CREDIT
		3	1	0	4

Course Objective: To understand and apply the fundamental concepts in graph theory. Apply theories and concepts to test and validate intuition and independent mathematical thinking in problem solving.

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.

Skill Development

SMTB7001	ALGEBRAIC NUMBER THEORY	L	T	P	EL	C
		3	1	0	0	4

Course Objectives:

- To prove theorems about integrals bases
- To develop unique factorization into ideals
- To solve Diophantine equations.

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 II	FERMAT'S LITTLE AND WILSON'S THEOREM	12 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 III	INNER PRODUCT SPACES	12 Hrs
Basic concepts Vector Spaces - linear independence and bases – Inner product spaces – Characteristic roots and matrices of a linear transformation		
UNIT IV	LINEAR HOMOGENEOUS EQUATIONS	12 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 V	HERMITIAN AND UNITARY MATRICES	12 Hrs
Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix Cayley - Hamilton theorem.		
Max Hrs: 60 Hrs		
REFERENCE BOOKS		
1. David M. Burton, Elementary Number Theory, Sixth Edn., TMH. 2005 2. Shanti Narayanan & Mittal, A Text Book of Matrices, Revised edn., S. Chand. 2010 3. C.Y. Hsiung, Elementary Theory of Numbers. Allied Publishers.1986 4. Neville Robbins, Beginning Number Theory, Second Ed. Narosa.1996 5. George E. Andrews, Number Theory, HPC. 1998 6. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education. 2000		
Skill Development		
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.

Skill Development

SMTB5107	MATHEMATICAL COMPUTATION WITH PYTHON	L	T	P	EL	C
		3	0	0	0	3

Course Objective:

- To enable the students to appreciate and understand some concepts of mathematics using python
- To solve differential equations analytically and numerically using python.
- To acquire proficiency in using python to present data graphically.

UNIT I PYTHON BASICS

9 Hrs

Introduction to Python: Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).

UNIT II BEGINNING PYTHON PROGRAMMING

9 Hrs

Creating Python Programs :Input and Output Statements, Control statements(Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments, Errors and Exceptions

UNIT III SYMBOLIC MATHEMATICS

9 Hrs

Introduction to the SymPy library for symbolic mathematics-Symbolic variables and expressions - Simplification, expansion, and substitution of expressions-Solving equations and systems of equations symbolically

UNIT IV NUMERICAL COMPUTATION

9

Hrs

Introduction to the NumPy- library for numerical computations- Working with arrays and matrices-Mathematical operations with NumPy arrays- Numerical differentiation and integration using SciPy- Solving Differential Equations- root finding.

UNIT V DATA VISUALIZATION WITH PYTHON

9 Hrs

Basic Plotting – Polynomial Fitting using matplotlib- Plotting trigonometric plotting using Matplotlib.

Max Hrs: 45 Hrs

TEXT/REFERENCE BOOKS:

1. Allen Downey, Jeffrey Elkner, Chris Meyers.How to think like a computer scientist learning with Python / 1st Edition,2012

2. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.
3. Fuhrer, Claus, Jan Erik Solem, and Olivier Verdier. *Scientific Computing with Python 3*. Packt Publishing Ltd, 2016.
4. Johansson, Robert. *Numerical Python: A Practical Techniques Approach for Industry*. Apress, 2015.
5. Millman, K. Jarrod, and Michael Aivazis. "Python for scientists and engineers." *Computing in science & engineering* 13.2 (2011): 9-12.



Skill Development

USEFUL WEBSITES:

1. <http://docs.python.org/3/tutorial/index.html>
2. <http://interactivepython.org/courselib/static/pythonds>
3. <http://www.ibiblio.org/g2swap/byteofpython/read/>

COURSE OUTCOME: At the end of the course, the student will be able to

CO1	To provide Basic knowledge of Python
CO2	To learn how to design and program Python applications
CO3	Develop proficiency in using SymPy, the symbolic mathematics library in Python
CO4	To learn Numerical computations with python
CO5	Understand different customization options available in Matplotlib to enhance the appearance and readability of the visualizations.
CO6	Explore different styles and themes available in Matplotlib for creating visually appealing plots



Skill Development

SMTB6101	MATHEMATICAL COMPUTATION WITH PYTHON - LAB	L	T	P	EL	C
		0	0	4	0	2

List of Experiments:

1. Introduction to Python Programming
2. Simple Python programs in Matrices
 - Addition, Subtraction
 - Matrix multiplication and inverse of a matrix
 - Determinant of a matrix
 - Eigen values and Eigen vectors
3. Basic mathematical operations
 - Sum of natural numbers
 - Finding factorial of a number
 - Finding square root and exponential of a given number
4. Program with relational conditional and logical Operators

- LCM and DCD of numbers
 - Finding max and min of given numbers
5. Symbolic computations
 - Program to check the consistency of given system of equations
 - Program to solve the system of equations
 - Program to find the root of the polynomial equation
 6. Numerical Computation using NumPy and Scipy
 7. Differentiation and Integration
 - Program to find the derivatives of the given function
 - Partial derivative of a given function
 - Find the limit of a function
 8. Plotting using matplotlib
 - Plotting standard curves
 - Line plot
 - Bar plot
 - Histogram
 9. Statistics
 - Mean
 - Median
 - Mode
 10. Solution of ordinary differential Equation

 Skill Development

SMTB7005	MATHEMATICAL MODELING	L	T	P	EL	C
		3	1	0	0	4

Course Objective:

- Identify the significance of Mathematical Modeling and the various types of Mathematical models applied in different fields.

Unit-I INTRODUCTION**12 Hrs**

Basic Steps of Mathematical Modeling, its needs, types of models, limitations, Elementary ideas of dynamical systems, Equilibrium point, node, saddle point, focus, centre and limit-cycle idea with simple illustrations and figures

Unit-II POPULATION MODELS

12 Hrs

Basic concepts, Exponential growth model, formulation , solution, interpretation and limitations. Compensation and depensation, Logistic growth model, formulation, solution, interpretation and limitations.

Unit-III EPIDEMIC MODELS

12 Hrs

Basic concepts, SI model, SIS model with constant coefficient, SIS model with coefficient as a function of time t , SIS model with constant number of carriers, SIS model when the carriers is a function of time t , SIR model, Epidemics with vaccination.

Unit-IV ECONOMIC MODELS

12 Hrs

Production and supply functions, price-elasticity, utility of consumption and consumer surplus, theory of production, production function.

Unit-V BIOLOGICAL MODELS

12 Hrs

Blood flow and oxygen transfer Modeling blood flow, viscosity, Poiseuille law, mathematical formulation of the problem, solution and interpretation.

Max.

Hrs: 60 Hrs

TEXT / REFERENCE BOOKS

1. Mark M. Meerschaert, Mathematical Modeling, Academic Press, New Work, 1993
2. W. Meyer , Concepts of Mathematical Modeling, McGraw Hill, New York, 1994
3. Beltrami , Mathematics for Dynamic Modeling, Academic Press, Orlando, Florida, 1987
4. N. Bailey, The Mathematical Theory of Infectious Diseases, Haftier press, New York, 1975

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

CO1	List the origin of Mathematical Modeling, needs and limitations
CO2	Discuss the components and facts of various Population models.
CO3	Sketch the models used to explore the epidemics
CO4	Analyze the nature of the Economic models
CO5	Summarize the science of blood flow and oxygen transfer
CO6	Organize how the Poiseuille law is applied for modeling biological flows

 Skill Development