SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED.

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

FACULTY OF ARTS / SCIENCE

M.A. /M. Sc. (First Year) (Applied Mathematics)

Syllabus

Effective from June-2019 onwards

Swami Ramanand Teerth Marathwada University, Nanded.

M. Sc. First Year (Applied Mathematics)(CBCS) Syllabus

Semester	Paper No.	Name of the paper	Hrs./ Week	Credits	Max. Marks		
					IA	EA (ESE)	Total
I	I	Modern Algebra	4	4	25	75	100
	II	Real Analysis	4	4	25	75	100
	III	Ordinary Differential Equations	4	4	25	75	100
	IV	Complex Analysis	4	4	25	75	100
	Elective-I V(A) V(B)	Choose any one Discrete Mathematics Mathematical Software: I	4	4	25	75	100
	VI	Tutorial-I/Lab Work (Compulsory)	2 Hrs /Batch/ week Max=25, Min=20	5		125	125
II	VII	Numerical Linear Algebra	4	4	25	75	100
	VIII	Classical Mechanics	4	4	25	75	100
	IX	Partial Differential Equations	4	4	25	75	100
	X	Numerical Techniques	4	4	25	75	100
	Elective-II XI(A) XI(B)	Choose any one: Probability Distributions and Testing of Hypothesis: Mathematical Software: II	4	4	25	75	100
	XII	Tutorial-II/Lab work (Compulsory)	2 Hrs /Batch/ week Max=25, Min=20	5		125	125
		Total		**50**			**1250**

Swami Ramanand Teerth Marathwada University, Nanded.

M.A. /M. Sc. First Year (Applied Mathematics) (CBCS) Syllabus

Effective from June-2019

First Semester		Second Semester	
Paper No.	**Name of the paper**	**Paper No.**	**Name of the paper**
I	Modern Algebra	VII	Numerical Linear Algebra
II	Real Analysis	VIII	Classical Mechanics
III	Ordinary Differential Equations	IX	Partial Differential Equations
IV	Complex Analysis	X	Numerical Techniques
One paper to be chosen from following papers which are taught in the department.			
V(A)	Discrete Mathematics	XI(A)	Probability Distributions and Testing of Hypothesis.
V(B)	Mathematical Software -I	XI(B)	Mathematical Software: II
VI	Tutorial-I (Compulsory)	XII	Tutorial-II (Compulsory)

M.Sc. Applied Mathematics

(2 years program)

Program Educational Objectives (PEOs):

PEO1: To equip students with knowledge, abilities and insight in mathematics and related fields.

PEO2: Have the ability to pursue interdisciplinary research in Indian Universities and abroad.

PEO3: Utilize the mathematical knowledge to provide solution for real life problems with the help of modelling, simulation.

PEO4: To enable them to work as a mathematical professional in industry or scientific researcher.

PEO5: To enable students to recognize the need for the ability to engage in life-long learning.

PROGRAMME OUTCOMES (POs):

After the completion of the program, students will able to:

PO1: Identify, formulate, and analyze the complex problems using the principles of Mathematics.

PO2: Solve real life problems by applying the Mathematical tools.

PO3: Apply the Mathematical concepts, in all the fields of learning including higher research, and recognize the need and prepare for lifelong learning.

PO4: Secure their place in leading business organizations anywhere in the world.

PO5: Apply ethical principles and commit to professional ethics, responsibilities and norms in the society.

PO6: Gain the knowledge of software which will be useful inthe Industry.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: To understand the concepts of applied mathematics.

PSO2: To develop the problems solving skills and computational skills.

PSO3: To enhance self-learning and improve own performance.

PSO4: To creates mathematical models and solving real life problems.

Paper-I

Modern Algebra

Max. Periods: 60 (04 Credits)

Course Objectives:

This course is aimed to learn basic concepts of algebraic structure such ascenter of group, centralizer, normal subgroup, solvalibility of groups, Sylow theorem. Also the concepts of rings.

Course Outcomes:

After completion of the course student will be able to

CO1: Define group and give examples of Group.

CO2: Attain mastery onNilpotent group, alternating group etc.

CO3: Gain Command on Sylows theorem.

CO4: Solve problems based on rings, maximal and prime ideals.

Unit-I:

Semi groups and groups, Subgroups and Cosets, Cyclic groups, Generators and relations, Normal subgroup and quotient group, Isomorphism theorems, Automorphism.

Unit-II:

Conjugacy and *G*-sets (Computational Aspect Only), Normal series, Solvable groups, Nilpotent groups, Permutation Groups, Cyclic decomposition, Alternating group A_n (Computational Aspect Only)

Unit-III:

Structure of groups, Direct product, Finitely Generated Abelian Groups (Computational Aspect Only), Invariants of a finite abelian group, Sylow Theorems (Computational Aspect Only).

Unit-IV:

Rings, Examples of rings, Types of rings, Subrings and Characteristic of a ring.Ideals and homomorphism (Computational Aspect Only), Maximal and prime ideals, Principal ideal, Unique Factorization Domains (Computational Aspect Only), Principal Ideal Domains, Euclidean Domains, Polynomials over UFD (Computational Aspect Only).

Text Book:

1. **P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul**, "Basic Abstract Algebra", (Second Ed.), Cambridge Univ. Press (Indian Ed.1995).

Scope: Unit I – Chapter 4 - Art 1, 2, 3, 4, 5, 6. Chapter 5. Art 1, 2, 3

Unit II – Chapter 5 - Art 4, Chapter 6 - Art 1, 2, 3 , Chapter 7 - Art 1, 2.

Unit III – Chapter 8 - Art 1, 2, 3, 4, 5.

Unit IV – Chapter 9 - Art 1, 2, 3, 4 Chapter 10 - Art 1, 2, 3, 4, 5. Chapter 11 - Art 1, 2, 3, 4.

Reference Books:

1. **Joseph A. Gallian**, "Contemporary Abstract Algebra", (Fourth Ed.), Narosa, 1999.
2. **I. S. Luthar and I. B. S. Passi**, "Algebra-Vol. 1: Groups", Narosa, New Delhi, 1996.
3. **V.K. Khanna, S.K. Bhambri**, "A Course in Abstract Algebra", Vikas Publicing House. (Second Edition)
4. **David Dummit and Richard Foote**, "Abstract Algebra", John Wiley and Sons. Paper-I

Paper-II
Real Analysis

Max. Periods: 60(04 Credits)

Course Objectives:

To introduce the concept of limit, continuity, differentiation, Taylors theorem, convergences of sequence and series of functions. Stone-Weierstress theorem, Abels theorem.

Course Outcomes:

After completion of the course student will be able to

Co1: Verifycontinuity of functions.

CO2: Acquire the knowledge of L'Hospital rule, derivatives of higher order.

CO3: Analyse convergence of sequence and series of functions.

CO4: Construct proof of Stone-Weierstress theorem, Abels theorem.

Unit-I:

Limits of functions, Continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic functions, Infinite limits and limits at infinity, Examples.

Unit-II:

The derivative of a real function, Examples, Mean value theorems, The continuity of derivatives, L - Hospital Rule, Derivatives of Higher order, Taylor's Theorem, Differentiation of vector valued functions, Examples.

Unit-III:

Sequence and series of functions: Pointwise convergence of a sequence and series of functions, Discussion of main problem, Uniform Convergence, Cauchy criterion for uniform convergence, Weierstrass M-Test for sequence and series of functions, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation.

Unit-IV:

Equicontinuous Families of Functions, The Stone-Weierstrass theorem (Statements only), Examples, Power Series, Abel's and Taylor's theorems, Uniqueness theorem for power series.

Text books:

1. **Walter Rudin**, "Principles of Mathematical Analysis", Third Edition, McGraw Hill, International Editions.

Scope: Unit-I Chapter 4.
Unit-II Chapter 5.
Unit-III Chapter 7(Article 7.1 to 7.18).
Unit IV- Chapter-7 (Article 7.19 to 7.28) & Chapter-8 (Article 8.1 to 8.5)

Reference books:

1. **Robert G. Bartle, Donald R. Sherbert**, "Introduction to Real Analysis, Wiley India Edition
2. **N.L. Carothers**, "Real Analysis", Cambridge University Press.
3. **H.L. Royden**, "Real Analysis', PHI Learning Pvt.Ltd.(Third Edition).

Paper no. III

Ordinary Differential Equations

Max. Periods:60 (04 credits)

Course Objectives:

This course introduces various methods to solve ordinary differential equations, non-homogeneous differential equations with variable coefficients, shortcut methods to solve ode. Also differential equations are solved by using software.

Course Outcomes:

After completion of the course student will be able to

CO1: Gain the concept of differential equations.

CO2: Solve ordinary differential equations.

CO3: Assimilate the Meaning of existence and uniqueness theorem.

CO4: Solution of ordinary differential equations with the help of software.

Unit I

Linear Equations of first order: solution of homogeneous and non-homogeneous linear equation of first order, Linear Equations with Constant Coefficients: Linear dependence and independence, A formula for the Wronskian.

Unit II

The non-homogeneous equation of order two, the homogeneous equation of order n, initial value problems for nth order equations, the non-homogeneous equation of order n, The Wronskian and linear independence. reduction of the order of homogeneous equation, homogeneous equation with analytic coefficients, the Legendre equation.

Unit III

Orthogonal trajectories of a given family of curves, Complete solution, method of finding complimentary function, rules to find particular integral, the homogeneous linear equations.

Unit IV

Simultaneous differential equations, equation of various types, equation which do not contain y directly, equation which do not contain x directly, equation whose one solution is known, normal form, method of solving linear differential equations by changing the independent variables.

Text Book

1) An Introduction to Differential Equation, E.A.Coddington, Prentice Hall of India Private Limited.
2) Advanced Engineering Mathematics by H.K. Dass, S. Chand and company ltd.

Scope

Unit I

An Introduction to Differential Equations, Chapter 1 (1.5-1.7), Chapter 2 (2.1--2.5)

Unit II

An Introduction to Differential Equations Chapter2 (2.6-2.8, 2.10) Chapter 3 (3.7,3.8)

Unit III

Advanced Engineering Mathematics, Chapter 3 (3.15 – 3.26)

Unit IV

Advanced Engineering Mathematics, Chapter 4 (3.27 – 3.35)

Reference Books:

1. Differential Equations by G. F. Simmons and S.G. Krantz, Tata McGraw Hill publication
2. Introductory course in Differential Equation by Daniel A., Murray University Press.
3. Elementary Differential Equations with Boundary value problems by William F. Trench

Paper No. IV
Complex Analysis

Max. Periods: 60(04 Credits)

Course Objectives:

This course introduces Mobius transformation, analytic functions, Cauchy's Theorem, Maximum Modulus Theorem. Also to learn Singularities.

Course Outcomes:

After completion of the course student will be able to

CO1: Solve problems on Mobius transformation,

CO2: Gain command on analytic functions.

CO3: Explain the Cauchy-Riemann equation, harmonic function.

CO4: Identify different types of singularities.

Unit-I:

Complex Number, Algebra of complex numbers, Rectangular and Polar representation of Complex numbers, Continuity, Differentiability, Cauchy–Riemann Equations, Analyticity, Harmonic Functions,

Unit-II:

Curves, Parameterizations, Line Integrals, Cauchy's Theorem.Cauchy's Integral Formulae, Taylor's Theorem, Cauchy's Inequality, Applications of Cauchy's Inequality, Liouville's Theorem and Applications, Maximum Modulus Theorem (Without Proof).

Unit-III:

Laurent Series, Singularities, Isolated Singularity, Non- Isolated Singularity. Residue of function, Residue Theorem, Applications of Residue Theorem, The Argument Principle, Rouche's Theorem.

Unit IV:

Mappings, The Exponential Function, Mapping Properties, The Logarithmic Function, Complex Exponents. Power Series, Maclaurin and Taylor Series, Operations on Power series.

Text Book:

1. S. Ponnusamy and Herb Silverman, "Complex Variables with Applications", Birkhauser Publication.

Scope: Unit 1- Art.1.1, 1.2, 1.3,2.5, 5.1,5.2,5.3
Unit 2- Art.7.1,7.2,7.3, 7.4, 8.1,8.2,8.3,
Unit 3- Art.9.1,9.2,9.3,9.4
Unit 4- Art.4.1,4.2,4.3,4.4,6.2,6.3,6.4

Reference Books:

1. John B. Convey, "Function of one complex variable", Narosa Pub. House, 1980.
2. S. Ponnusamy, " Foundations of Complex Analysis", Narosa Publishing House

Paper no. V(A)
Discrete Mathematics and Applications
Max. Periods: 60(04 Credits)

Course Objectives:

The aim of this course is to study Lattices and Boolean algebra, application of graphs. Also it consists of Travelling Salesman Problem, tree and its properties, circuit, Coloring, Kuratowski's two graphs, Covering and Partitioning.

Course Outcomes:

After completion of the course student will be able to
CO1: Explain Boolean algebra and its properties.
CO2: Acquire mastery on Travelling Salesman Problem
CO3: Assimilate spanning trees, network flows.
CO4: Illustrate Matrix Representation of Graphs.

Unit I: Lattices and Boolean Algebra: Lattice as Partially Ordered Sets, Definition and Examples, Some Properties of Lattices, Lattices as Algebraic Systems, Sublattices, Direct Product, and Homomorphism, Some Special Lattices, Boolean Algebra, Definition and Examples, Subalgebra, Direct Product, and Homomorphism, Boolean Functions, Boolean Forms and Free Boolean Algebras, Values of Boolean Expressions and Boolean Functions.

Unit II: Introduction: What is a Graph, Application of Graphs, Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, Brief History of Graph Theory. Paths and Circuits: Isomorphism, Subgraphs, Walks, Paths and Circuits, connected graphs, Disconnected Graphs, and Components, Euler Graphs, Operations of Graphs, More on Euler Graphs, Hamiltonian Paths and Circuits, The Travelling Salesman Problem.

Unit III: Trees and Fundamental Circuits: Trees, Some Properties of Trees, Pendant Vertices in a Tree, Distance and Centre in a Tree, Rooted and Binary Tree, On Counting Trees, Spanning Trees, Fundamental Circuits, Finding all Spanning trees of a Graph, Finding Spanning Trees in Weighted Graph, Cut-Sets and Cut-Vertices: Cut-sets, Some properties of Cut-sets, All cut-sets in a graph, Fundamental Circuits and Cut-sets, Connectivity and Separability, Network Flows,

Unit IV: Planner and Dual Graphs: Combinatorial Vs. Geometric Graph, Planar Graphs, Kuratowski's two graphs Different representations of a Planar Graph, Matrix Representation of Graphs: Incidence matrix, Submatrices of *A(G),* Circuit Matrix, Fundamental Circuit Matrix and Rank of *B,* Coloring, Covering and Partitioning: Chromatic Number, Chromatic Partitioning, Chromatic Polynomial

Text Books:

1. J. P. Tremblay and R. Manohar: Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw- Hill.

Scope: Chapter 4: Sec. 4-1, 4-1.1, 4-1.2, 4-1.3, 4-1.4, 4-1.5, 4-2, 4-2.1, 4-2.2, 4-3, 4-3.1, 4-3.2,

2. NarsinghDeo: Graph Theory with Applications to Engineering and Computer Science, PHI.

Scope: Chapter 1: Complete, Chapter 2: Complete, Chapter 3: Complete, Chapter 4: Sec. 4-1 to 4-6,Chapter 5: Sec. 5-1 to 5-4, Chapter 7: Sec. 7-1 to 7-4, Chapter 8: Sec. 8-1 to 8-3.

Reference Books:

1. Liu C. L.: Elements of Discrete Mathematics, Mc Graw Hill, 1985.
3. John Clark and Allan Holton: Graph Theory.
4. Douglas B. West: Introduction to Graph Theory, 2nd Edition, Pearson Education.
5. Rao S.S, Engineering Optimization: Theory and Practice, New Age International Pvt. Ltd., 3rd Edition 1998.
6. J.P. Tremblay &R. Manohar: Discrete Mathematical Structures with Applications to Computer Science: Tata McGraw- Hill.

Paper No. V(C)

Mathematical Software: I (LATEX)

Max. Periods: 60(04 Credits)

Course Objectives:

The aim of the course is to introduce Latex for mathematical typing like mathematical symbols and formulas, various equations, diagrams, tables, fancy header and footer, research paper, thesis, books etc.

Course Outcomes:

After completion of the course student will be able to

CO1: Install Latex software.

CO2: Typeset any document which involve Mathematical expressions.

CO3: Insert images, graphs, tables using LATEX software.

CO4: Prepare presentation using software.

Unit I:

Introduction to LaTeX, Installation of LaTeX, Layout Design, LaTeX input files, Input file structure, document classes, packages, environments, page styles, Typesetting texts, Fancy Header,

Unit II:

Tables, Inline math formulas and displayed equations, Math symbols and fonts, Delimeters, matrices, arrays, Typesetting Mathematical formulae: fractions, Integrals, sums, products, etc.

Unit III:

Producing Mathematical Graphics. Document classesfor paper writing, thesis, books, etc. Table of contents, index, bibliography management, hypertext, pdf pages.

Unit IV

Geometry, fancy header and footer, Verbatim, itemize, enumerate, boxes, equation number, citing references, styles, practical examples.

Reference Books:

1. LATEX for Beginners, Workbook, Edition 5

Scope: Unit I Chapter 1,2, Unit II Chapter 3, Unit III Chapter 4 Unit IV Chapter 5,6

Reference Books:

1. George Gratzer, ‘‘ Practical LATEX’’ , Springer
2. Stefan Kottsitz, ‘‘ LATEX Beginners Guide ’’ open sourse.

Paper No. VI

Tutorial –I

05 Credits

Papers	Marks	Credits
Tutorial on theory paper –I	25	1
Tutorial on theory paper-II	25	1
Tutorial on theory paper-III	25	1
Tutorial on theory paper-IV	25	1
Tutorial on theory paper – V(A/B)	25	1
Total	**125**	**5**

The format for scheme of marking for tutorial of 25 marks in each paper is as follows:

Tutorial:----- Paper No. and name:-----

Name of the teacher:-----

Sr.No.	**Name of the student**	**Seat No.**	**Seminar**	**Attendance**	**Viva**	**Lab. Work**	**Total**
			05 Marks	**05 Marks**	**05 Marks**	**10 Marks**	**25 Marks**

Signature of Teacher

The format, in which, the marks obtained by students in tutorial of 125 marks, to be submitted by HOD through the Principal, to the department of examination S.R.T.M.U. Nanded is as follows:

Sr. No.	**Name of the student**	**Seat No.**	**Tutorial**					**Total**
			Paper No.----	**Paper No.----**	**Paper No.----**	**Paper No.----**	**Paper No.----**	
			Marks out of 25	**Marks out of 25**	**Marks out of 25**	**Marks out of 25**	**Marks out of 25**	**Marks out of 125**

Head of the Department

Paper No. VII
NUMERICAL LINEAR ALGEBRA
Max. Periods: 60(04 Credits)

Course Objectives:

This course includes types of matrices, difference between vector and matrix norm, error, inner product of two vectors, stability of the algorithm and accuracy of the solution, Householder Transformations and applications, Electrical Circuit Problems, Polynomial fitting method with applications.

Course Outcomes:

After completion of the course student will be able to

CO1: Analyse permutation, HessenbergCompanion, Non derogatory.

CO2: Construct basic algorithms for computing Norm of a vector.

CO3: Gain command over Householder Transformations and applications to QR factorization.

CO4: Introduce Polynomial fitting method with applications

Unit 1:

Basic concepts and problems in Matrix and Linear Algebra, Emphasis onto some special matrices including Permutation, Hessenberg, Companion, Non derogatory, Diagonally dominant, Positive definite type of matrices, Difference between vector and matrix norm.

Unit 2:

Calculating errors at the time of various numerical calculation, Calculating the error Bounds for floating - Point Matrix computations, Basic algorithms for computing Norm of a vector, Inner product of two vectors, solution of an Upper Triangular system and other systems. Finding the condition on stability of the algorithm and accuracy of the solution.

Unit 3:

LU factorization without and with Pivoting and stability of method. Householder Transformations and applications to QR factorization and Hessenberg Reduction. Solving linear system through numerical method with existence, uniqueness and invariance of solution. Applications to Electrical Circuit Problems, ODE, PDE.

Unit 4:

Geometric interpretation of the Least Squares problem, Polynomial fitting method with applications leading to an over determined system and itsexistence, uniqueness. Basic laws of floating, Error analysis for Forward Elimination and Backward substitution.

Recommended Book:

Title: Numerical Linear Algebra and Applications (2nd Edition) by Biswa N. Datta by PHI
Chapter0: (0.1- 0.3) ; Chapter1: 1.1- 1.8 ;Chapter 2: 2.1- 2.7; Chapter3: 3.1- 3.4
Chapter5: 5.1-5.4 ;5.6 - 5.7; Chapter6: 6.1- 6.3; 6.9- 6.10 ; Chapter7: 7.1- 7.5
Chapter11: 11.1- 11.3.

Reference Books:

1. Numerical Linear Algebra by L. N. Trefethen (SIAM: Society for Industrial and Applied Mathematics)
2. Applied Numerical Linear Algebra by James Demmel (SIAM: Society for Industrial and Applied Mathematics)
3. Numerical Linear Algebra by V. Sundarapandian(Prentice Hall India Learning Pvt. Ltd.)
4. Numerical Linear Algebra by G. Allaire, Sidi Mahmoud Kaber, K. Trabelsi. (Springer Publications)

Paper-VIII
Classical Mechanics

Max. Periods: 60(04 Credits)

Course Objectives:

This course elaborates the concept of constraints, degree of freedom, D'Alembert's principle, Lagrange's equation of motion andtheir application. Also Hamiltonian, principale of Least action, fundamental lemma of calculus of variation and Eulers, Langranges equation.

Course Outcomes:

After completion of the course student will be able to

CO1: Define and understand basic mechanical concepts related to constraints, degree of freedom and generalize coordinates.

CO2: Derive expression for Simple pendulum, Atwood machine etc

CO3: Describe and understand the motion of mechanical system using Lagrange- Hamilton formulization.

CO4: ExplainBrachistochrone Problem, Isoperimetric Problems.

UNIT I:

Survey of the Elementary Principles: Mechanics of a particle, Mechanics of a system of particles, Constraints, D'Alemberts principle and Lagrange's equations, Velocity-dependent potentials and the dissipation function – Simple applications of the Lagrangian formulation, Single particle in space (only Cartesian coordinates), Atwood's machine.

UNIT II:

Variational Principles and Lagrange's Equations: Hamilton's principle, Derivation of Lagrange's equation from Hamilton's principle, Extending Hamilton's principle to systems with constraints, Conservation theorems and symmetry properties, Energy function and the conservation of energy.

UNIT III:

The Hamilton Equations of Motion: Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Routh's procedure, Derivation of Hamilton's equations from a variationalprinciple, The principle of least action.

UNIT IV:

Calculus of Variations: Functional, Linear Functional, Euler Equation, Others form of Euler Equation, Extremal, Shortest Distance between two points, Minimum surface of Revolution, Brachistochrone Problem, Examples, Isoperimetric Problems, Examples, Functional of second order derivatives, examples.

Text Book:

1. H. Goldstein, Charles Poole, John Sabko, "Classical Mechanics", Pearson 3rd Edition 2002.

Scope: Unit-I Chapter 1.
Unit-II Chapter 2 (Article 2.1, 2.3, 2.4, 2.6, 2.7).
Unit-III Chapter 8**.**

2. H.K. Dass, Advanced Engineering Mathematics, S. Chand & Company Pvt. Ltd.

Scope: Unit IV- Chapter-17.

Reference Books:

1. N. Rana and B. Joag, "Classical Mechanics", Tata McGraw Hill 1991.
2. A.S. Ramsey, "Dynamics Part II" The English Language Book Society and Cambridge University press, 1972.
3. I.M. Gelfand and S.V. Fomin "Calculus of Variations" Prentice Hall.

Paper no. IX

Partial Differential Equations

Max. Periods: 60(04 Credits)

Course Objectives:

The aim of the course is to introduce partial differential equations,classification of pdf, various methods to solve pde, Analytic expression for Monge cone. Also it introduces solution methods to solve second order partial differential equation, Harnacks theorem.

Course Outcomes:

After completion of the course student will be able to

CO1: Classify partial differential equations.

CO2: Solve of Partial Differential Equations to find complete integral.

CO3: Gain command over Canonical Forms.

CO4: Introduce boundary conditions and solve problems on it.

Unit I:

Curves and surfaces, Genesis of first order PDE, classification of integrals, Definitions of integrals, linearpartial differential equations of first order, Pfaffian differential equations, compatible systems.

Unit II:

Charpits method, Jacobi's method, integral surface through a given curve, Quasi-linear equations, Cauchy problem, Analytic expression for Mongecone,non-linear first order partial differential equation. Examples.

Unit III:

Genesis of second order partial differential equation, classification of second order partial differential equation, vibrations of an infinite string, vibrations of semi-infinite string, vibrations of a string of finite length, method of separation of variables.

Unit IV:

Boundary value problems, Maximum and Minimum principles, the Cauchy problem, the Dirichlet problem, Neumann problem, Harnacks theorem, heat conduction problem, Duhamels principle, classification in the case of n-variables. Solution of second order pde by using Mathematical softwares.

Text Book

1. An Elementary course in Partial Differential Equations by ''(2^{nd} edition) by T Amarnath, Narosa Publishing House, New Delhi

Scope:

Unit I Chapter 1.1-1.6, Unit II Chapter 1.7-1.11, Unit III Chapter 2.1 to 2.3, Unit IV Chapter 2.4 to 2.7

Reference Books:

1. Elements of partial differential equations by I .N. Sneddon (Mc-Graw Hill Book company)
2. Partial differential equations by E.T. Copson (Cambridge university press)
3. Introduction to partial differential equations by K. Sankara Rao

Paper No. X

Numerical Techniques

Max. Periods: 60(04 Credits)

Course Objectives:

The study includes various methods like Newton- Rrphson method, Muller method, Gauss Elimination method, Model problems, Newton divided difference, Lagranges interpolating polynomials are derived.

Course Outcomes:

After completion of the course student will be able to

CO1: Analyse rate of convergence.

CO2: Solve system of equation using numerical methods.

CO3: Solve problems on Gauss-Seidel Method, Jacobi Iteration Method, Successive Over Relaxation Method.

CO4: Construct Langrange Interpolating Polynomial, Newton's Divided Difference Interpolating Polynomial.

Unit-I:

Transcendental and Polynomial equations: Introduction, Bisection method, Secant and Regula Falsi Method, Newton - Raphson Method, Muller Method, Chebyshev Method, Multi Point Iteration Method, Rate of Convergence (Without Proof) Bierge – Vieta Method, Birstow Method, Model problems.

Unit-II:

System of *n* equations in *n* unknowns. Direct methods to solve the system of *n* equations in *n* unknowns: Cramer's Rule, Gauss elimination method, Jordan elimination Method, Triangularization Method, Cholesky Method, Partition Method, Model Problems.

Unit-III:

Iteration methods to solve the system of *n* equations in *n* unknowns: Gauss-Seidel Method, Jacobi Iteration Method, Successive Over Relaxation Method, Eigen value and Eigen vectors, Eigen Value Problem, Model problems.

Unit-IV:

Interpolations: Introduction, Vandermonde's Determinant, Interpolating Polynomial, Langrange Interpolating Polynomial, Newton's Divided Difference Interpolating Polynomial, Aitken's Interpolating Polynomial, Quadratic Interpolation, Higher order Interpolating polynomials, Finite difference operators, Interpolating polynomials using finite difference operators, Model Problems.

Text Book:

1. M.K. Jain, SRK Iyengar, R.K. Jain, "Numerical methods for Scientific and Engineering computations." New Age International Limited Pub.

Scope: Unit 1- Art.2.1,2.2,2.3,2.4,2.5,2.8
Unit 2- Art.3.1,3.2,3.3,
Unit 3- Art.3.4,3.5,3.6
Unit 4- Art.4.1,4.2,4.3,4.4

Reference Books:

1. S.S. Sastry, "Introductory methods of Numerical Analysis" Prentice- Hall of India Private Ltd. (Second Edition) 1997.
2. E.V. Krishnamurthi& Sen. "Numerical Algorithm," Affiliate East. West press. Private Limited 1986.

Paper no.XI (A)

Probability Distributions and Testing of Hypothesis

Max. Periods: 60(04 Credits)

Course Objectives:

To develop the next generation of statistics professionals while increasing the statistical literacy of students. Course is focused on Bayestheorem, Properties of Variance, Poisson distribution and various tests are introduced to the students.

Course Outcomes:

After completion of the course student will be able to

CO1: Solve problems on Multiplication theorem of probability, independent events.

CO3: Analyse Distribution Function, Discrete and Continuous Random variable, Generating function.

CO3: Apply knowledge of Poisson distribution to solve problems.

CO4: Gain command on Students t-Distribution, Applications of F-distribution etc.

Unit-I:

Basic Definitions, Mathematical and statistical probability, Axiomatic approach, Theorems on probability, Conditional probability, Multiplication theorem of probability, independent events, Multiplication theorem of probability for independent events, Baye's theorem,

Unit-II:

Distribution Function, Discrete and Continuous Random variable, p. d. f., Mathematical Expectation of a Random Variable, Properties of expectation, Properties of Variance Moment Generating function, Properties of Moment generating function, Cumulants and its properties,

Unit-III:

Binomial distribution, Moments of Binomial distribution, Recurrence relation for Moments of Binomial distribution, m. g. f. and c. g. f. of binomial distribution, Poisson distribution, Moments of Poisson distribution, Recurrence relation for Moments of Poisson distribution, MGF of Poisson distribution, Cumulants of Poisson distribution.

Unit-IV:

Exact Sampling Distributions-I, Chi-square distribution, MGF and CGF of Chi-square distribution, Applications of Chi-square distribution, Inference about a Population Variance, Goodness of Fit test, Test of independence of attributes, Exact Sampling Distributions-II, Student's t-Distribution, Limiting form of t-distribution, Applications of t-distribution, t-test for single mean, t-test for difference of means, Paired t-test for difference of means F-distribution, Applications of F-distribution, F-test for equality of population variances

Text Book:

1.S .C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand and Sons, New Delhi.

Scope:

Unit I Chapter 3: 3.1 Chapter 4: 4.2

Unit II Chapter 5: 5.1 to 5.4, 5.4 Chapter 6: 6.1 to 6.5

Unit III Chapter 7: 7.1, 7.1.2, 7.2, 7.2 Chapter 8: 8.4, 8.4.1, 8.4.2, 8.4.6, 8.4.9, 8.5, 8.5.1, 8.5.2, 8.5.4, 8.5.5, 8.5.7
Unit IV Chapter 15: 15.1, 15.2, 15.3, 15.3.1, 15.6, 15.6.1, 15.6.2, 15.6.3,
Chapter 16: 16.1, 16.2, 16.2.5, 16.3, 16.3.1, 16.3.2, 16.3.3, 16.5, 16.6, 16.6.1

Reference Books:

1. Dudewicz E.J. & Mishra S.N.(1988): Modern Mathematical Statistics, Wiley Series
2. Lehman E.L. (1987): Theory of Testing of Hypotheses. Student Edition.
3. Ferguson T.S. (1967): Mathematical Statistics: A decision Theoretical Approach. Academic Press.
4. ZacksS.(1971): Theory of Statistics Inference- John Wiley and Sons, New York
5. Freund J.E. Prentics -Mathematical Statistics Hall of India.

Paper no XI(B)

Mathematical Software: II

Max. Periods: 60(04 Credits)

Course Objectives:

In this course determinant and Matrix computations are introduced for study. Various loops are introduced to develop programming skills, solution of ode and pde is obtained by using mathematical software.

Course Outcomes:

After completion of the course student will be able to

CO1: Perform basic computations.

CO2: Gain command on loops, solution difficulties while using software.

CO3: Plot graphs and perform various operations using control expression.

CO4: Solve differential equations using software.

Unit-I:

Introduction, Current directory, The command window, The edit window, M-files, The figure window, Matrices, Operators, Functions, Matrix arithmetic, Operator precedence functions, Keyboard input, Formatted output, Plotting toolbox.

Unit-II:

Liner algebra in Matlab: Solution difficulties, Simultaneous equations, Inconsistent equations, Under-determined problems, Over-determined problems, Conditioned problems,

Unit III

Tap-down design and branching statements, Relational operators and logical operators, Plotting features, Loops: Repetition for loop, Modifying the control expression, While loop,

Unit-III:

Working with while loop, Control expression, Programming with loops, Logical arrays and logicalindexing, User definedfunctions, Data types, Recursion, Solution of ordinary, partial and fractional differential equations

Text Book:

1. J. Michael Fitzpatrick and JohnD. Crocetti, “Introduction to Programming with Matlab”.
   Scope: Chapters 2 to 6

Reference Books

2. RudraPratap, “Getting started with MATLAB”.
3. Marc E. Herniter, “Programming in MATLAB”, Books/Cole, Thomson learning inc.

Paper No. XII

Tutorial –II

05 Credits

Papers	Marks	Credits
Tutorial on theory paper –I	25	1
Tutorial on theory paper-II	25	1
Tutorial on theory paper-III	25	1
Tutorial on theory paper-IV	25	1
Tutorial on theory paper – V(A/B)	25	1
Total	**125**	**5**

The format for scheme of marking for tutorial of 25 marks in each paper is as follows:

Tutorial:----- Paper No. and name:-----

Name of the teacher:-----

Sr.No.	**Name of the student**	**Seat No.**	**Seminar**	**Attendance**	**Viva**	**Lab. Work**	**Total**
			05 Marks	**05 Marks**	**05 Marks**	**10 Marks**	**25 Marks**

Signature of Teacher

The format, in which, the marks obtained by students in tutorial of 125 marks, to be submitted by HOD through the Principal, to the department of examination S.R.T.M.U. Nanded is as follows:

Sr. No.	**Name of the student**	**Seat No.**	**Tutorial**					**Total**
			Paper No.----	**Paper No.----**	**Paper No.----**	**Paper No.----**	**Paper No.----**	
			Marks out of 25	**Marks out of 25**	**Marks out of 25**	**Marks out of 25**	**Marks out of 25**	**Marks out of 125**

Head of the Department

Swami Ramanand Teerth Marathwada University, Nanded.

Question Paper pattern

FACULTY OF ARTS / SCIENCE

M.A. /M. Sc. (First Year) (Applied Mathematics) (CBCS Pattern)

w. e. f. June-2019 onwards

Time: 03.00 Hrs. **Max. Marks: 75**

Q. No. 1:	**Attempt the following.**		**Unit No. I**
	a)	Theory	8 marks
	b)	Problem	7 Marks
	or		
	c)	Theory	8 marks
	d)	Problem	7 Marks
Q. No. 2:	**Attempt the following.**		**Unit No. II**
	a)	Theory	8 marks
	b)	Problem	7 Marks
	or		
	c)	Theory	8 marks
	d)	Problem	7 Marks
Q. No. 3:	**Attempt the following.**		**Unit No. III**
	a)	Theory	8 marks
	b)	Problem	7 Marks
	or		
	c)	Theory	8 marks
	d)	Problem	7 Marks
Q. No. 4:	**Attempt the following.**		**Unit No. IV**
	a)	Theory	8 marks
	b)	Problem	7 Marks
	or		
	c)	Theory	8 marks
	d)	Problem	7 Marks
Q. No. 5:	**Attempt any three of the following.**		**Unit No. I, II, III, IV**
	a)	Theory / Problem	
	b)	Theory / Problem	5 Marks Each
	c)	Theory / Problem	
	d)	Theory / Problem	

Total **75**

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