Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

SYLLABUS

For

M. Sc. Mathematics

M. Sc. (Sem. I to II)

Choice based credit system

To be implemented

From

(June 2019-2020)

Syllabus for M.Sc. I (Mathematics)

Preamble:

M. Sc. Mathematics programme is of 100 credits spread over four semesters. The programme emphasizes both theory and applications of Mathematics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics. The department has the academic autonomy and it has been utilized to add the new and need based elective courses. The syllabus of the first year (two semesters) covers most of the core courses. In the third semester syllabus there are two core courses and six elective courses. In the fourth semester syllabus there are two core courses and six elective courses. The syllabus has been framed to have a good balance of theory, methods and applications of Mathematics.

M.Sc. Programme objectives

1. To provide students with rigorous and thorough knowledge of a broad range of pure and applied areas of mathematics.
2. To impart knowledge from basic and advanced level concepts with applications in various fields of mathematics.
3. To establish inter-disciplinarily between mathematics and other subjects from Humanities and the Social Sciences.
4. To train students to handle the problems faced by industry through Mathematical knowledge and scientific computational techniques.
5. To introduce the fundamentals of Mathematics to strengthen the students' logical and analytical ability.

M.Sc. Programme outcomes:

1. Pursue research in reputed institutions and solve the existing mathematical problems using the knowledge of pure and applied mathematics.
2. Acquire the strong foundation of basic concepts which will benefit them to become good academicians. The students will be eligible to pursue higher studies abroad.
3. Critically interpret data, write reports and apply the basics of rules of evidence.
4. Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.
5. Recognize the need to engage in lifelong learning through continuing education and research.

Program Specific Objectives of the Course:

1. It is expected to groom the students into qualitative scientific manpower.
2. Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics. It is expected to be well grounded in the basic manipulative skills.
3. To inculcate innovative skills, team work, ethical practices among students so as to meet societal expectations.
4. To inculcate the curiosity for mathematics in students and to prepare them for future research.

Program Specific Outcomes:

After successful completion of M.Sc. Mathematics Course student will be able to:

1. Apply the knowledge of mathematical concepts in interdisciplinary fields.
2. Understand the nature of abstract mathematics and explore the concepts in further details.
3. Pursue research in challenging areas of pure/applied mathematics.
4. Employ confidently the knowledge of mathematical software and tools for treating the complex mathematical problems and scientific investigations.
5. Effectively communicate and explore ideas of mathematics for propagation of knowledge and popularization of mathematics in society.

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Scheme of the Programme

Name of the Programme : M.Sc.(MATHEMATICS) SEMESTER-I			
Course Code	**Course Type**	**Name of the course**	**Credits**
MMT 101	Core	Algebra-I	05
MMT 102	Core	Advanced Calculus	05
MMT 103	Core	Real Analysis	05
MMT 104	Core	Differential Equations	05
MMT 105	Core	Classical Mechanics	05
		Total Credits	**25**

M: M.Sc. M: Mathematics T: Theory, P: Practical.

M.Sc-I Semester-I

Course Code: MMT 101

Title of Course: Algebra – I

Course Objectives: Students should

1. study group and ring theory in details and basics and to introduce the concept of modulus over a ring.
2. appreciate the necessity of various Algebraic structures with binary operations such as Group, Ring, and Non-commutative ring that lead to new ideas in algebra for their future research in advanced topics of algebra.
3. motivate students for research studies in mathematics and related fields.
4. get knowledge of a wide range of mathematical techniques and application of mathematical methods

Unit I. : Simple groups, simplicity of A_n (n>5), Commutator subgroups, normal subgroup and subnormal series, Jordan-Holder theorem, Solvable groups, isomorphism theorems, Zassenhaus Lemma, Schreier refinement theorem. **(15 L)**

Unit II. : Group Action on a set, isometry subgroups, Burnside theorem, syllow's theorems, p-subgroups, class equation and applications. **(15 L)**

Unit III. : Rings of polynomials, Factorization of polynomials over fields, irreducible polynomials, Eisenstein criterion, ideals in F[x], unique factorization domain, principle ideal domain, Gauss lemma, Euclidean Domain. **(15 L)**

Unit IV. Modules, sub-modules, quotient modules, homomorphism and isomorphism theorems, Fundamental theorem for modules. **(15 L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1. understand the concepts of Commutator subgroup, normal subgroup and subnormal series.
2. construct refinements for normal and subnormal series.

Uni t – II: After completion of the unit, Students are able to:

1. learn the concept of group action and class equation.
2. apply sylow theorems to identification of simple groups.

Uni t – III: After completion of the unit, Students are able to:

1. understand the concept of UFD and PID.
2. apply Eisenstein criterion to identify irreducible polynomials.

Uni t – IV: After completion of the unit, Students are able to:

1. define Modules and its properties.
2. understand Fundamental theorem for modules.

REFERENCE BOOKS:

1. John Fraleigh, A First course in Abstract Algebra, Narosa publishing house New Delhi, (3rd edition).

2. C. Musili,Ring and Modules, Narosa publishing house.

3. Joseph A.Gallian ,Contempory Abstract Algebra, Narosa Publication 4th Edition, 1999.

4. Bhattachary Jain and nagpal ,Basic Abstract Algebra, New Delhi ,Narosa Publication House, 2nd Edition.

5. I.N.Herstein ,Topics in Algebra,Vikas Publishing house.

6. N.Jacobson ,Basic Algebra,Hind Publishing Corporation, 1984.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.

ii) General /Specific instructions for Laboratory safty should be given whenever necessary.

Course Code: MMT 102

Title of Course: Advanced Calculus

Course Objectives: Students should

1. learn pointwise and uniform convergence of sequence of functions.
2. learn rearrangement of sequence and series and effect of rearrangement on sum or limit.
3. learn Multivariable Calculus.
4. get knowledge of a line integral and properties.

Unit 1: Sequence of function: Pointwise convergence of sequence of function, Examples of sequence of real valued functions, Definition of uniform convergence, Uniform convergence and continuity, Cauchy condition for uniform convergence, Uniform convergence and Riemann Integration, Uniform convergence and Differentiation, double sequence, Uniform convergence and double sequence, Mean Convergence.

(15 L)

Unit 2: Rearrangement of Series, subseries, double series , Rearrangement theorem for double series,Multification of series, Power series, Real Power series, The Taylors series generated by function,Bernstein's theorem, Binomial series,Abel's limit theorem ,Taubers theorem **(15 L)**

Unit 3 : Multivariable differential Calculus: The Directional Derivative, The Directional Derivative and Continuity, Total Derivative, Total Derivative in terms of partial derivative ,The Matrix of linear function ,Jacobian Matrix, Chain Rule, Mean value function for differentiable function, A sufficient condition for differentiability, sufficient condition for equality of mixed partial derivatives, Taylors formula for functions R^n to R^1 ,The Inverse function theorem (statement only), Implicit function theorem (statement only) and their applications, Extrema of real valued function of one variable, Extrema of real valued function of several variables

(15 L)

Unit 4:- Path and line integral, Multiple integral Double integral (Theorem without proof) Application to Area and Volume, (Theorem without proof) ,Greens theorem in the Plane. Applications of Green's theorem's. Change of variables Special case for transformation formula, Surface Integral, Change of parametric representation. Other notations for Surface Integral, stokes theorem, Curl and divergence of the vector field, Gauss divergence theorem

(15 L)

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1. compare pointwise and uniform convergent sequence of functions.
2. understand relation between convergence and continuity, differentiability, Integrability.

Uni t – II: After completion of the unit, Students are able to:

1. rearrange the series of functions and check the effect on convergence.
2. apply Weierstrass M-test to check the uniform convergence of sequence of functions.

Uni t – III: After completion of the unit, Students are able to:

1. understand the concept of directional derivative and able to compute the derivative in given direction.
2. understand Implicit function theorem.

Uni t – IV: After completion of the unit, Students are able to:

1. define line integral and path integral.
2. apply Greens and stokes theorem to compute area of region.

REFERENCE BOOKS:

1) T.M.Apostol **,**Mathematical Analysis, Narosa publishing house, second edition.

2) T.M.Apostol ,Advanced Calculus, Volume II.

3) Walter Rudin ,Principles of Mathematical Analysis, McGraw Hill book Company,third edition

4) Richard Goldberge ,Methods of Real Analysis, Blaisdell publishing Company.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.
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Course Code: MMT 103

Title of Course: Real Analysis

Course Objectives: Students should

1. learn Lebesgue outer Measure and Lebesgue Measurable Sets.
2. learn Lebesgue Measurable functions and properties.
3. learn concept of Lebesgue Integration.
4. learn norm linear space and inequalities.

UNIT -1: Open Sets, Closed Sets and Borel sets, Lebesgue Outer measure, The sigma Algebra of Lebesgue Measurable Sets, Countable Additivity, Continuity and Borel-Cantelli Lemma, Non-measurable Sets**.** **(15L)**

UNIT – 2: Sums, Product and Composition of Measurable Functions, Sequential Pointwise limits and simple Approximation. Littlewood's Three Principles, Egoroff's theorem and Lusin's Theorem, Lebesgue Integration of a Bounded Measurable Function, Lebesgue Integration of a non- negative Measurable function. (**15 L)**

UNIT-3: The General Lebesgue Integral, Characterization of Riemann and Lebesgue Integrability, Differentiability of Monotone Functions, Lebesgue's Theorem, Functions of Bounded Variations: Jordan's theorem**.** **(15 L)**

UNIT-4: Absolutely Continuous Functions, Integrating Derivatives: Differentiating Indefinite Integrals, Normed Linear Spaces, Inequalities of Young, Holder and Minkowski, the Riesz- Fischer Theorem.

(15 L)

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1**.** understand Lebesgue outer measure and its properties.
2. construct non Measurable sets from a set with positive outer measure.

Uni t – II: After completion of the unit, Students are able to:

1. understand Lebesgue Measurable functions and simple approximation theorem.
2. state Littlewoods three principles and there proofs.

Uni t – III: After completion of the unit, Students are able to:

1. compare Reimann Integration and Lebesgue Integral.
2. calculate Lebesgue Integral of Measurable functions.

Uni t – IV: After completion of the unit, Students are able to:

1. compare the inequalities and their applications.
2. understand Riesz- Fischer Theorem .

REFERENCE BOOKS:

1. Royden, H.L. Fitzpateick P.M ,Real Analysis, New Delhi ,Prentice Hall of India, (2009) ,4th edition.

2. G. deBarra ,Measure Theory and Integration, McMillan, New York,1981.

3. Jain. P.K. and Gupta V.P, Lebesgue measure and integration, , Wiley Easter Limited, 1986.

4. Rudin W .,Principles of Mathematical Analysis, McGraw- Hill Book Co., 1964.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.

ii) General /Specific instructions for Laboratory safty should be given whenever necessary

Course Code: MMT 104

Title of Course: Differential equations

Course Objectives: Students should

1. learn procedure to find Wronskian and its properties.
2. learn Initial value problems and reduction to initial value problem.
3. learn Sturm Liouville theory and The Legendre equations.
4. learn Bessel equation and singular points at infinity.

Unit- 1: Linear Equations with constant coefficients: The second order homogeneous equations, Initial value problems for second order equations, Linear dependence and independence, A formula for the Wronskian, The non- homogeneous equations of order two, The homogeneous equations of order n**.**

(15 L)

Unit -2: Initial value problems for the n^{th} order equations< The non-homogeneous equations of n^{th} order. Linear Equations with variable coefficients: Initial value problems for the homogeneous equations. Solutions of the homogeneous equations, The Wronskian and linear independence, Reduction of the of a homogeneous equation, the non-homogeneous equations,

(15 L)

Unit-3: Green's function, Sturm Liouville theory, Homogeneous equations with analytic coefficients, The Legendre equations. Linear equations with regular singular points: The Euler equations, Second order equations with regular singular points. **(15 L)**

Unit -4: The Bessel equation, Reguolar singular points at infinity, Existance and uniqueness of solutions: The method of successive approximations, The Lipschitz condition of the successive approximation. Convergence of the successive approximation.

(15 L)

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1. solve liner and second order homogeneous equation with constant coefficient.
2. check linear dependence and independence using Wronskian .

Uni t – II: After completion of the unit, Students are able to:

1. understand and solve n^{th} order non homogeneous linear equation with variable coefficient.
2. solve initial value problem.

Uni t – III: After completion of the unit, Students are able to:

1. understand Green's function, Sturm Liouville theory.
2. solve homogeneous equations with analytic coefficients and obtain series solution.

Uni t – IV: After completion of the unit, Students are able to:

1. understand the Bessel equation and calculate regular singular points at infinity.
2. understand Lipschitz condition of the successive approximation.

REFERENCE BOOKS:

1) E.A. Coddington **,** An introduction to ordinary differential equations, Prentice Hall of India Pvt. Ltd.New Delhi., 1974.

2) G. Birkoff and G.G. Rota ,Ordinary Differential equations, John Willey and Sons.

3) G.F.Simmons, Differential equations with Applications and Historical note, McGraw Hill, Inc.

New York. , 1972.

4) E.A. Coddington and Levinson ,Theory of Ordinary Differential equations, McGraw Hill, New York (1964).

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.

ii) General /Specific instructions for Laboratory safty should be given whenever necessary.

Course Code: MMT 105

Title of Course : Classical Mechanics

Course Objectives: Students should

1. learn conservative force and D'Alembert's Principle.
2. learn Geodesics in a plane and space to find maximum and minimum enclosed area.
3. learn Hamiltonian function and Routh's procedure.
4. learn Kinematics of rigid body motion.

UNIT-I: Mechanics of a particle, Mechanics of a system of particles, conservation theorems, conservative force with examples, constraints, Generalized co-ordinates, D'Alembert's Principle, Lagrange's equations of motion , the forms of Lagrange's equation for non-conservative system and partially conservative and partially non-conservative system, Lagrangian for charged particle in electromagnetic field, kinetic energy as a homogeneous function of generalized velocities, Non-conservation of total energy due to the existence of non-conservative forces. Cyclic co-ordinates and generalized momentum, conservation theorems, motion of a particle under central force and first integral. **(15 L)**

UNIT-II: Functionals , basic lemma in calculus of variations, Euler-Lagrange's equations , first integrals of Euler-Lagrange's equations, the case of several dependent variables Undetermined end conditions, Geodesics in a plane and space, the minimum surface of revolution , the problem of Brachistochrone, Isoperimetric problems, problem of maximum enclosed area, shape of a hanging rope. Hamilton's principle for conservative and non-conservative systems, Derivation of Hamilton's principle from D'Alembert's principle, Lagrange's equations of motion for conservative and non-conservative systems from Hamilton's principle. Lagrange's equations of motion for non-conservative systems(method of Lagrange's undetermined multipliers) **(15 L)**

UNIT –III : Hamiltonian function, Hamiltonian Canonical equations of motion, Derivation of Hamilton's equations from variational principle, Physical significance of Hamiltonian, the principle of least action, Jacobi's form of the least action principle, cyclic co-ordinates and Routh's procedure. Orthogonal transformations, Properties of transformation matrix, infinitesimal rotations. **(15 L)**

UNIT –IV: The Kinematics of rigid body motion: The independent co-ordinates of rigid body, the Eulerian angles, Euler's theorem on motion of rigid body, Angular momentum and kinetic energy of a rigid body with one point fixed, the inertia tensor and moment of inertia, Euler's equations of motion, Caley- Klein parameters, Matrix of transformation in Caley Klein parameters, Relations between Eulerian angles and Caley-Klein parameters**.** **(15 L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1. understand conservative force and find degrees of freedom.
2. understand Lagrange's equations of motion.

Uni t – II: After completion of the unit, Students are able to:

1. solve Isoperimetric problems.
2. understand Hamiltonian principle for conservative and non conservative force.

Uni t – III: After completion of the unit, Students are able to:

1. understand canonical equation of motion.
2. understand properties of transformation matrix, infinitesimal rotations.

Uni t – IV: After completion of the unit, Students are able to:

1. understand kinematics of Rigid body with one point fixed.
2. understand Matrix of transformation in Caley Klein parameters.

REFERENCE BOOKS:

1. Goldstein, H.,Classical Mechanics, Narosa Publishing House, New Delhi., 1980

2. Weinstocks , Calculus of Variations with applications to Physics and Engineering (International Series in Pure and Applied Mathematics), , Mc Graw Hill Book Company, New York.,1952.

3) Whittaker , A treatise on the Analytical Dynamics o f particles and rigid bodies, E.T., Cambridge University Press, 1965.

4) N.C. Rana and P.S.Joag, Classical mechanics, Tata McGraw Hills, New Delhi., 1991.

5) V.B. Bhatia, Classical Mechanics with Introduction to Non-linear Oscillation and Chaos, Narosa publishing House, 1997.

6) A.S. Gupta, Calculus of Variations with applications, Prntice Hall of India, 1997.

NOTE: - i) The details of field work, seminar, Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.

ii) General /Specific instructions for Laboratory safty should be given whenever necessary.

M.Sc-I Semester-II

Name of the Programme : M.Sc.(MATHEMATICS) SEMESTER-II			
Course Code	**Course Type**	**Name of the course**	**Credits**
MMT 201	Core	Linear Algebra	05
MMT 202	Core	Topology	05
MMT 203	Core	Complex Analysis	05
MMT 204	Core	Numerical Analysis	05
MMT 205	Core	Differential Geometry	05
		Total Credits	**25**

Course Code: MMT 201

Title of Course: Linear Algebra

Course Objectives: Students should

1. learn algebra of linear transformation.
2. learn inner product spaces.
3. learn canonical forms and its examples.
4. learn Hermitian and self adjoint linear transformation.

UNITS	**No. of Lectures**
UNIT-I : Direct sum of a vector space, Dual Spaces . Annihilator of a subspace, Quotient Spaces. Algebra of Linear transformation.	(**15 L)**
UNIT-II: Adjoint of a Linear Transformation, Inner product spaces, eigen values and eigen vectors of a linear transformation. Diagonalization. Invariant subspaces.	(15 **L)**
UNIT-III: Canonical forms, Similarity of Linear transformations, Reduction to Triangular forms, Nilpotent transformation, Primary decomposition theorem, Jordan blocks and Jordan forms , Invariants of Linear transformations**.**	**(15 L)**
UNIT-IV: Hermitian, Self adjoint, Unitary and normal linear transformation, symmetric bilinear forms, skew symmetric bilinear forms, group preserving bilinear forms	(15 **L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1**.** find annihilator of subspace and its properties.
2. understand dual space and gives examples of dual spaces.

Uni t – II: After completion of the unit, Students are able to:

1. understand adjoint of a Linear Transformation and eigen values and eigen functions.
2. understand Diagonalization and identify diagonalizable matrices.

Uni t – III: After completion of the unit, Students are able to:

1. obtain canonical form.
2. obtain Jordan blocks and Jordan forms**.**

Uni t – IV: After completion of the unit, Students are able to:

1. understand Unitary and normal Linear transformation.
2. understand skew symmetric bilinear forms, group preserving bilinear forms.

REFERENCE BOOKS:

1. I.N Herstein, Topics in Algebra, Willey eastern Ltd ,Second Edition.

2. Hoffman Kenneth and Kunze R ,Linear Algebra, Prentice hall of India, Pvt. Ltd., 1984.

3. Sahi and Bist ,Linear algebra, Narosa Publishing House.

4) A.R. Rao and P. Bhimashankaran ,Linear Algebra, Hindustan Book Agency (2000).

5) Surjit Sing, Linear Algebra, Vikas Publishing House ,1997.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.
ii) General /Specific instructions for Laboratory safty should be given whenever necessary.

Course Code: MMT 202

Title of Course: Topology

Course Objectives: Students should

1. learn Topological spaces and their geometric properties.
2. learn homeomorphic topological spaces.
3. learn compact and connected spaces.
4. learn completely regular and completely normal Spaces.

Unit –I : Topological Spaces, Examples, Open Sets, Closed sets, Neighborhoods, Bases, Subbases, Limit Points, Closer Interior, Various ways of defining topologies, Hereditary properties. (15 **L)**

Unit –II Continuous functions,Homeomorphisms,Topological properties, Compact Spaces, Connected spaces ,Connected subspaces of real lines, Components, Separation axioms T_0, T_1 , T_2 axioms. (**15 L)**

Unit –III First and second axioms spaces, Separable Spaces, Lindelof spaces, Regular and normal Spaces, Product Spaces (For T0, T1, T2 Compact and Connected) (**15 L)**

Unit IV Completely regular and completely normal Spaces, Urysohn Lemma and Urysohn Motorization theorem (**15 L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1**.** understand open sets and closed sets.
2. understand limit points and identify limit points.

Uni t – II: After completion of the unit, Students are able to:

1. understand compact Spaces, connected spaces.
2. understand separation axioms T_0, T_1, T_2 axioms.

Uni t – III: After completion of the unit, Students are able to:

1. understand separable spaces, Lindelof spaces.
2. understand regular and normal Spaces, Product Spaces**.**

Uni t – IV: After completion of the unit, Students are able to:

1. understand completely regular and completely normal Spaces.
2. understand Urysohn Lemma and Urysohn Motorization theorem.

REFERENCE BOOKS:

1. W.J.Pervin **,**Foundations of General Topology, Academic Press, New York, 3rd edition, 1970.

2. G.F. Simmons ,Introduction to Topology and Modern Analysis, Mc Graw Hill Book Company, New Delhi, 1963.

3. J.R. Munkers ,Topology a first Course, Prentice Hall of India Pvt.Ltd.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.
ii) General /Specific instructions for Laboratory safty should be given whenever necessary.

Course Code: MMT 203

Title of Course: Complex Analysis

Course Objectives: Students should

1. learn power series and its properties.
2. learn Analytical functions and solve problems.
3. learn Laurent series and classification of singularities.
4. learn completely regular and completely normal Spaces.

Unit 1: Power series, Radius of convergence, Bilinear Transformation, Analytic functions, Cauchy's-Riemann equations, Harmonic functions, Power series representation of analytic functions. **(15 L)**

Unit 2: Zeros of Analytic functions, Cauchy's theorem, Moreras theorem, Cauchy's Integral formula, Cauchy's inequality' Liouville's Theorem, Fundamental theorem of algebra, Maximum modulus theorem, Open mapping theorem. **(15L)**

Unit 3: Laurent series expansion theorem, Cauchy residue theorem, classification of singularities, Evaluation of integral, the argument principle, Rouche's theorem. **(15L)**

Unit 4: Conformal maps, Normal families, Hurwitz theorem, Riemann mapping theorem. **(15 L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1. calculate radius of convergence of power series.
2. understand power series representation of analytic functions.

Uni t – II: After completion of the unit, Students are able to:

1. understand Cauchy theorem and calculate zeroes of analytical function.
2. understand Fundamental theorem of algebra, Maximum modulus theorem, Open mapping theorem...

Uni t – III: After completion of the unit, Students are able to:

1. understand Laurent series expansion theorem.
2. understand the argument principle, Rouche's theorem**.**

Uni t – IV: After completion of the unit, Students are able to:

1. understand conformal maps, Normal families.
2. understand Hurwitz theorem, Riemann mapping theorem.

REFERENCE BOOKS:

1. J.B.Conway **,**Functions of one complex variable, Narosa publication House, 3rd Edition.
2. Alfors L.V ,Complex Analysis, McGraw 1979.
3. Herb Silverman ,Complex Analysis.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.

ii) General /Specific instructions for Laboratory safty should be given whenever necessary

Course Code: MMT 204

Title of Course: Numerical Analysis

Course Objectives: Students should

1. learn Different Numerical methods.
2. learn error estimation and Numerical integration.
3. learn Runge cutta method and Taylor's series Method.
4. learn Convergence, consistancy, sufficient condition for convergence.

Unit 1

Rate of convergence of Secant Method, Regula _Falsi Method and Newton-Raphson Method. Barstow method, Matrix factorization methods (Doo little reduction, Crout reduction) Eigen Values and eigen vectors, Gerschgorin theorem, Breuer theorem, Jacobi Method for symmetric matrices.

(15L)

Unit 2

Numerical Integration: Error estimates of trapezoidal and Simpson's Numerical Integration rule. Gauss- Legendre integration Methods (n= 1, 2), Lobatto Integration Method (n=2), Radau Integration method (n=2) and their error estimates. (**15 L)**

Unit 3

Runge – Kutta Method: second order methods, the coefficient tableau, third order methods (without proof), order conditions, Fourth order methods (without proof), Implicit Runge- kutta methods, Stability characteristics, Taylor Series Methods: Introduction to Taylor series methods, Manipulation of Power Series, an example of a Taylor series solution. **(15 L)**

Unit 4

Linear multistep methods: Adams Methods, General form of linear multistep methods, Predictor- corrector Adams methods, Starting Methods.
Analysis of linear multistep methods: Convergence, consistancy, sufficient condition for convergence, Stability characteristics**.** **(15 L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1**.** calculate rate of convergence & find eigen values and eigen vectors.
2. understand significance of different Numerical Methods and solve examples.

Uni t – II: After completion of the unit, Students are able to:

1. understand Numerical Integration and find Numerical Integration.
2. calculate error term in Numerical Integration.

Uni t – III: After completion of the unit, Students are able to:

1. understand Runge – Kutta Method & Taylor Series Methods.
2. Solve examples on Runge – Kutta Method & Taylor Series Methods**.**

Uni t – IV: After completion of the unit, Students are able to:

1. understand Linear multistep methods.
2. understand Analysis of linear multistep methods.

REFERENCE BOOKS:

1. M. K. Jain, S. R. K.lyengar, R.K.Jain, Numerical methods for scientific and Engineering computation, New Age international Limited Publishers, 6th edition .

2. J.C. Butcher ,Numerical methods for ordinary differential equations, John Wiley & sons Ltd, 2nd Edition .

3. P. Henrici ,Discrete variable methods in ordinary differential equations, John Wiley & Sons Ltd.

4. S.S. Sastry ,Introductory methods of Numerical analysis, Prentice Hall of India New Delhi.

NOTE:- i)The details of field work ,seminar ,Group discussion and Oral examination be given whenever necessary. 1Hr per week for problem solving /tutorial/seminars.
ii) General /Specific instructions for Laboratory safty should be given whenever necessary

Course Code: MMT 205

Title of Course: Differential Geometry

Course Objectives: Students should

1. learn Euclidean space, curve and their properties.
2. learn The Frenet Formulae & Frenet approximation of curves.
3. learn Co-ordinate Patches, Fundamental forms of a surface.
4. learn The Shape operator, Computational Techniques and Asymptotic and Geodesic Curves.

Unit – I

Vector Space, Euclidean Space in R^3. Tangent Vectors and vector fields, Frame fields, Natural Frame Fields, Directional Derivatives, Curve in R^3 and reparametrization of curves, Standard curves, Speed of curve, length of curve, 1-forms, differential forms**.** **(15 L)**

Unit –II

The Frenet Formulae for unit speed curve,. Frenet approximation of curves, Arbitrary Speed Curves, Frenet formula's for arbitrary speed curves, Co-variant Derivative, Isometries in R^3, Orthogonal Transformations.

(15 L)

Unit-III

Co-ordinate Patches, Surface in R^3, Simple Surface, Cylinder Surface, Surface of Revolution and parameterization of a region, parameterization of a cylinder and surface of revolution, Smooth overlapping patches, Tangent and normal vector fields on a surface. **(15 L)**

Unit-IV

The Shape operator of surface M in R^3, Normal curvature, Principal curvature, Gaussian and mean curvatures, Umbilic Points, Fundamental forms of a surface, Computational Techniques, Special curves on surface, Asymptotic and Geodesic Curves**.** **(15 L)**

Course Outcomes:

Uni t – I: After completion of the unit, Students are able to:

1**.** calculate directional derivative and reparametric expression of curve.
2. understand Euclidean space and its properties.

Uni t – II: After completion of the unit, Students are able to:

1. understand geometrical meaning of Franet Formulae.
2. calculate Franet Apparatus.

Uni t – III: After completion of the unit, Students are able to:

1. understand patch to the surface and its meaning.
2. Compute patch to the surface**.**

Uni t – IV: After completion of the unit, Students are able to:

1. understand meaning of shape operator and its properties.
2. compute shape operator.

REFERENCE BOOKS:

1. O'Neill **,** Elementary Differential Geometry, B. Academic Press, Revised Edition, 2006.

2. D. Somasundaram ,Differential Geometry – First Course, Narosa Publishing House, New Delhi , 2010