Swami Ramanand Teerth Marathwada University, Nanded
School of Mathematical Sciences

Two Year M. A. / M. Sc. Degree Program in Mathematics

Revised Syllabi of M. A. / M. Sc. in Mathematics

(Choice Based Credit System)

(To be implemented in the Department of Mathematics, Swami Ramanand Teerth Marathwada University, Nanded)

(With effect from Academic Year 2014-2015)

1. Structure of the course: M.A./M.Sc. (Mathematics)-First Semester (CBCS Pattern)

SEMESTER-I								
Sr. No.	**Course**	**Course Title**	**Theory/ Practical Paper**	**No. of Credits**	**Marks@ 25/Credit**	**Internal Component (50%)**	**Semester End Component (50%)**	**Grand Total**
MTU-101	Core I	Algebra-I(Groups & Rings)	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-102	Core II	Real Analysis-I	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-103	Core III	Complex Analysis	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-104	Core IV	Advanced Discrete Mathematics	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-105(A)/ (B)/(C)	Elective Group I	Multivariate Calculus/ Differential Geometry of Manifolds- I/ Dynamics and continuum Mechanics-I	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-106	Practical I	Lab Course-I (Programming in C or C++ and Practicals in Numerical Analysis)	**p**	**5**	**125**	**50**	**75**	**125**
		Total						**625**

List of Core/ Elective Subjects to be offered

Core Subjects

1. Algebra-I(Groups & Rings)
2. Real Analysis-I
3. Complex Analysis
4. Advanced Discrete Mathematics

Elective Subjects

Elective Group I (Any one for First Semester)

1. Multivariate Calculus
2. Differential Geometry of Manifolds- I
3. Dynamics and continuum Mechanics-I

NOTE:

- First semester will have five Theory papers and assessment for each theory paper will be of 100 Marks [50 External Exam+ 50 Internal Exam (02 tests each of 15 Marks+20 Marks for assignment].
- Lab course viz. MTU-106 will be of 125 marks [50 internal Exam + 75 External Exam (50 marks for Practical exam + 10 marks for Practical Record + 15 marks for Practical Viva-Voce)].
- Lab course Internal Examination includes internal test + Seminars by using Power Point Presentation.
- One credit is of 25 marks.
- Minimum 40% Marks are required for passing in each of the above head i.e. separate passing in External Exam and that in Internal Exam.
- Practical will be evaluated by one external examiner (out of University examiner) and one internal examiner.

SEMESTER-I

MTU- 101: ALGEBRA-I (Groups & Rings)

(Max. Periods: 60)

(**Prerequisites**: Introduction to Groups, Definition and Examples, Elementary properties of Groups, Finite Groups and Subgroups, Subgroup Tests, Examples of Subgroups).

UNIT I: Cyclic Groups, Properties of Cyclic Groups, Classification of Subgroups of Cyclic Groups, Permutation Groups, Definition and Notation, Cycle Notation, Properties of Permutations, A Check-Digit Scheme Based on D5. **(12L+3T)**

UNIT II: Isomorphisms, Definition and Examples, Cayley's Theorem, Properties of Isomorphisms, Automorphisms, Cosets and Lagrange's Theorem, An Application of Cosets to Permutaion Groups, External direct products, Normal Subgroups, Factor Groups, Application of Factor Groups. **(12L+3T)**

UNIT III: Internal Direct Product, Group Homomorphisms and their properties, The First Isomorphism Theorem, The Fundamental Theorem, Isomorphism Classes of Abelian Groups, Proof of Fundamental Theorem, The Class Equation, The Sylow Theorem. **(12L+3T)**

UNIT IV: Introduction to Rings, Examples and Properties, Integral Domains, Fields, Characteristic of a Ring, Ideals and Factor Rings, Ring Homomorphisms, Polynomial Rings, Factorization of Polynomials, Divisibility in Integral Domains, Unique Factorization Domains, Euclidean Domains. **(12L+3T)**

Text Book:

J. A. Gallian, Contemporary Abstract Algebra, Fourth edition, Narosa Publishing House.

Scope: Chapter 4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,24.

Reference Books:

1. D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd Ed., John Wiley, 2002.
2. M. Artin, Algebra, Prentice-Hall of India Pvt. Ltd.
3. I. N. Herstein, Topics in Algebra, Macmillan, Indian Edition.
4. J. B. Fraleigh, Abstract Algebra, 5th Edition.
5. I. S. Luthar, I. B. S. Passi, Algebra, Vol. 1, Groups, Narosa Publishing House.
6. P. B. Bhattacharyya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2e), Cambridge Univ. Press, Indian Edition, 1997.

MTU- 102: Real Analysis-I.
(Maximum Number of Periods: 60)

Unit I :The real numbers, Limits and continuity, Equivalence and cardinality, The Cantor set, Monotone functions, Metric spaces, Normed vector spaces, More Inequalities, Limit in metric spaces, Open sets, Closed sets, The relative metric. **(12L+3T)**

Unit II: Continuous functions, Homeomorphism, The space of continuous functions, connected sets, Completeness, Totally Bounded sets, Complete Metric spaces, Fixed points, completions. **(12L+3T)**

Unit III: Compactness, Compact metric space, Uniform continuity, Equivalent Metrics, Discontinuous functions, The Baire category theorem. **(12L+3T)**

Unit IV: Sequences of functions, Historical Background, Point wise and uniform convergence, Interchanging limits, the space of bounded functions, The space of continuous functions, the Weierstrass theorem, Trigonometric polynomials, Infinitely differentiable functions. Equicontinuity, Continuity and category, The Stone Weierstrass theorem. **(12L+3T)**

Text Book: - N.L. Carothers, "Real Analysis", Cambridge university press.
Scope : - Chapters 1 to 12.
Reference Books:

1. Sudhir R. Ghorpade and Balmohan V. Limaye, "A Course in Calculus and Real Analysis", Springer Publications.
2. T. M. Apostol, "Mathematical Analysis", Narosa Publishing House.
3. G. F. Simmons, "Introduction to Topology and Modern Analysis", Mc Graw Hill.
4. S. Kumaresan, "Topology of Metric Spaces", Narosa Publishing House.
5. W. Rudin, "Principles of Mathematical Analysis", Mc Graw Hill.

MTU-103: Complex Analysis.
(Maximum Number of Periods: 60)

Unit I: Functions, Limit and Continuity, one-to-one and onto functions, Concepts of limit and continuity, Sequences and series of functions, Analytic functions and power series, Differentiability and Cauchy-Riemann Equations, Harmonic functions, Power series as an analytic Function, Exponential and Trigonometric functions, Logarithmic functions, Inverse functions.

(12L+3T)

Unit II: Complex Integration, Curves in the complex plane, Properties of complex line integrals, Cauchy-Goursat theorem, Simple connectivity, Cauchy Integral Formula, Morera's Theorem, Existence of Harmonic conjugate, Zeros of an analytic function, Laurent series. **(12L+3T)**

Unit III: Conformal Mappings, Principle of conformal mapping, Basic properties of Möbius map, Fixed points and Möbius maps, Triples to Triples under Möbius map (cross ratio and its invariance properties). Maximum principle, Schwarz's Lemma and Liouville's Theorem, Maximum modulus principle, Hadamard's three circles/ Lines theorem, Schwarz Lemma and its consequences, , Doubly periodic entire functions, Fundamental theorem of Algebra, Zero's of certain polynomials.

(12L+3T)

Unit IV: Classifications of singularities, Isolated and non-isolated singularities, Removable singularities, Poles, isolated singularities at infinity, Meromorphic functions, Essential singularities and Picard's theorem, Residue at a finite point, Residue at infinity, Residue theorem, Number of zeros and poles, Rouche's theorem. **(12L+3T)**

Text Book: - S.Ponnusamy, "Foundation of Complex Analysis", Narosa Publication, Second Edition.

Scope: Chapters 1 to 8.

Reference Books:

1. John B. Convey, "Functions of one Complex Variable", Narosa Publishing House.
2. L. V. Ahlfors, "Complex Analysis", Mc Graw Hill.
3. Ruel V. Churchil, J.W. Brown, "Complex Variables and Applications", Mc Graw Hill.
4. H.Silverman, "Functions of Complex Variables".
5. T.W.Gamelin, Complex Analysis, Springer Publications.

MTU - 104: Advanced Discrete Mathematics
(Maximum Number of Periods: 60)

Unit I: Formal Logic**:** Statements, Symbolic Representation and Tautologies, Quantifiers, Predicates and validity, PrepositionalLogic. Semi groups and Monoids**:** Definitions and example of Semigroups and Monoids (including those pertaining to concatenation operations) Homomorphism of semigroups and monoids, Congruence relation and quotient semigroups, Subsemigroup and submonoids, Direct product, Basic Homomorphism Theorem.

(12L+3T)

Unit II: Lattices: Lattices as partially ordered sets, their properties. Lattices as algebraic systems. Sublattices, Direct products and Homomorphisms, Some special lattices e. g. complete. Complemented and Distributive Lattices.

(12L+3T)

Unit III: Boolean Algebras**:** Boolean Algebras as Lattices, Various Boolean Identities, The switching Algebra. Example, subalgebras, Direct Products and Homomorphisms, Joint-irreducible elements. Atoms and Minterms, Boolean forms and their equivalence, Minterm Boolean forms, Sum of Products, Canonical forms, Minimization of Boolean functions, Applications of Boolean Algebra to Switching Theory(using AND, OR and NOT gates.)The Karnaugh Map method.

(12L+3T)

Unit IV: Coding Theory**:** Group codes, the communication model and basic notion, error correction, generation of codes by using parity checks, error recovering in group codes, Hamming distance. **(12L+3T)**

Reference Books:

1. Discrete Mathematical Structures with applications to Computer Science, By J. P. Trembley and Manohar, McGraw-HillBookCo.1997.
2. Finite Mathematics(International edition1983),By Seymour Lipschutz, McGraw-Hill Book
3. Discrete Mathematics-A Unified Approach,By S.Wiitala, McGraw-Hill Book Co. New York.
4. Mathematical Structures for Computer Science, (3rd edition) By J. L. Gersting.

MTU-105(A) :Multivariate Calculus
(Maximum Number of Periods: 60)

Unit I : Introduction: - Level sets and Tangent spaces, Lagrange's multipliers, Maxima & Minima on open sets. **(12L+3T)**

Unit II : Line integral, Frenet-Serret equations, Double Integration parameterized surfaces in R^3. , Surface Area, Surface Integral. **(12L+3T)**

Unit III : Stoke's Theorem, Triple integral, The Divergence theorem. **(12L+3T)**

Unit IV : Geometry of surfaces in R^3, Gaussian curvatures, Geodesic curvature. **(12L+3T)**

Text Book: Sean Dineen, "Multivariate Calculus and Geometry", Springer Verlag.
Scope: Chapters 11 to 18.

Reference Books:

1. Sudhir R. Ghorpade and Balmohan V. Limaye, "A course in Multivariate Calculus and Analysis", Springer Verlag.
2. T. M. Apostol, "Calculus", Vol. 2, Second Edition, John Wiley and Sons, Inc.
3. J. A. Thorpe, "Elementary Topics in Differential Geometry", Springer Verlag.
4. Devinatz, "Advanced Calculus".
5. B. Oneill, Elementary Differential Geometry.
6. J. E. Marsden, A. J. Tromba, A. Weinstein, Basic Multivariable Calculus, Springer Internationsl Edition, Springer Verlag

MTU-105(B): Differential Geometry of Manifolds -1
(Maximum Number of Periods: 60)

Unit I: Differentiable Manifolds: Definition and examples of differentiable manifolds. Tangent spaces, Jocobian map. **(12L+3T)**
Unit II: One parameter group of transformations Lie -derivatives. Immersions and imbedding. Distributions. Exterior algebra. Exterior Derivative. **(12L+3T)**
Unit II: Lie Groups and Lie Algebras: Topological groups. Lie groups and Lie algebras. Product of two Lie groups. **(12L+3T)**
Unit IV: One parameter subgroups and exponential maps. Examples of Lie groups. Homomorphism and Isomorphism. Lie transformation groups. General linear groups. **(12L+3T)**

Reference Books:

1. A course in tensors with applications to Riemannian geometry, By R. S. Mishra, Potishala (Pvt) Ltd. 1965.
2. Structures on a differentiable manifold and their applications, By R. S. Mishra, Chandrama Prakashan, Allahabad, 1984.
3. An Introduction to Modern Differential Geometry, By B. B. Sinha, Kalyani Publishers, NewDelhi, 1982.
4. Structure of Manifolds, By K. Yono and M. Kon, World Scientific Publishing Co. Pvt. Ltd. 1984.

MTU-105(C): Dynamics and continuum Mechanics-I
(Max No. of Periods - 60)

Unit I: Vector Methods: Vector moment about a point and scalar moment about an axis, Vector and scalar couples, Centroids, Vector calculus. **(12L+3T)**

Unit II: Kinematics of Particles and Rigid Bodies: Velocity and acceleration of a Particle along a curve, Motion in plane – radial and transverse components, Relative velocity and acceleration, Vector angular velocity, General motion of rigid body, Moving axes. **(12L+3T)**

Unit III: Newtons Laws of Motion: Mass, Momentum, Force, Newton's laws of motion, Work, Energy and Power, Conservative forces- potential energy, Impulsive forces. Motion of a system of particles: Linear momentum of system of particles, Angular momentum and rate of change of angular momentum. Use of centroids, Moving origins, Impulsive force. **(12L+3T)**

Unit IV: Moments and products of Inertia,The theorem of parallel and perpendicular axes, Angular Momentum, Principal axes, Kinetic Energy of a rigid body, Momental Ellipsoid, Coplanar distribution, General motion of a rigid body, Two Dimensional Rigid Body Dynamics**:** Problems illustrating the laws of motion, Problems illustrating the law of conservation of energy, Problems illustrating the impulsive motion. **(12L+3T)**

Text Book:

F. Chorlton: A text book of Dynamics (E.L.B.S.) (2^{nd} Edition)

Reference Books:

1. J.L. Synge and Griffith: Classical Mechanics.
2. Atkin R.H. : Classical Dynamics.