Swami Ramanand Teerth Marathwada University,

Vishnupuri, Nanded. (Maharashtra), India.

SCHOOL OF MATHEMATICAL SCIENCES

M.A. /M. Sc. (Mathematics) I and II Year Course structure and Syllabus.

Swami Ramanand Teerth Marathwada University, Nanded.

M.A. /M. Sc.(Mathematics) I and II Year Syllabus (Campus School) CGPA

- **(M.Sc. (Mathematics)-I syllabus is w. e. f. JUNE-2012)**
- **(M.Sc. (Mathematics)-II syllabus is w. e. f. JUNE-2013)**

M.Sc. (Mathematics)-I year

SEMESTER-I		SEMESTER-II	
Paper No.	**Name of the paper**	**Paper No.**	**Name of the paper**
MTU-101	Algebra-I(Groups & Rings)	MTU-201	Linear Algebra
MTU-102	Real Analysis-I	MTU-202	Real Analysis-II
MTU-103	Complex Analysis	MTU-203	Topology
MTU-104	Advanced Discrete Mathematics	MTU-204	Elementary Number Theory
Any one of the following MTU-105(A) to MTU-105(C) which will be taught in the School		**Any one of the following MTU-205(A) to MTU-205(C) which will be taught in the School**	
MTU-105(A)	Multivariate Calculus	MTU-205(A)	Differential Equations
MTU-105(B)	Differential Geometry of Manifolds- I	MTU-205(B)	Differential Geometry of Manifolds- II
MTU-105(C)	Dynamics and continuum Mechanics-I	MTU-205(C)	Dynamics and continuum Mechanics-II
MTU-106 (Compulsory to all the students)	**Lab Course-I** Programming in C or C++ and Practicals in Numerical Analysis	MTU-206 (Compulsory to all the students)	**Lab Course-II** Software Scilab and Practicals in Linear algebra, Number Theory, Analysis

M.Sc. (Mathematics)-II year

SEMESTER-III		SEMESTER-IV	
Paper No.	**Name of the paper**	**Paper No.**	**Name of the paper**
MTU-301	Algebra II (Field Theory and Galois Theory)	MTU-401	Boundary Value Problems
MTU-302	Functional Analysis	MTU-402	Integral Equations and transforms
Any three papers from MTU-303 to MTU- 310 which will be taught in the School		**Any three papers from MTU-403 to MTU-416 which will be taught in the School**	
MTU-303	Graph Theory	MTU-403	Probability Theory
MTU-304	Operations Research	MTU-404	Algorithms and their analysis.
MTU-305	Advanced Number Theory	MTU-405	Commutative Algebra
MTU-306	Lattice Theory	MTU-406	Classical Mechanics
MTU-307	Coding Theory	MTU-407	Theory of Relativity
MTU-308	Riemannian Geometry	MTU-408	Representation Theory of finite groups
MTU-309	Theory of Linear Operators	MTU-409	Algebraic Topology
MTU-310	Wave Propagation	MTU-410	Difference Equations
MTU-311 (Compulsory to all the students)	**Lab Course -III** MATLAB and Programmes using MATLAB : Optimization Problems, ODE and PDE, Mathematical Models	MTU-411	Fuzzy sets and their applications
		MTU-412	Advanced Functional Analysis.
		MTU-413	Algebraic Number Theory.
		MTU-414	Computational Geometry
		MTU-415	Fluid Dynamics
		MTU-416	Baer * rings.
		MTU-417 (Compulsory)	LATEX and Project Work

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M.A. /M. Sc. (Mathematics) Syllabus Semester-I

(For Campus School)

Swami Ramanand Teerth Marathwada University, Nanded.

SCHOOL OF MATHEMATICAL SCIENCES

M.Sc. (Mathematics)-I year (CGPA)

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SEMESTER-I	
Paper No.	**Name of the paper**
MTU-101	Algebra-I(Groups & Rings)
MTU-102	Real Analysis-I
MTU-103	Complex Analysis
MTU-104	Advanced Discrete Mathematics
Any one of the following MTU-105(A) to MTU-105(C) which will be taught in the School	
MTU-105(A)	Multivariate Calculus
MTU-105(B)	Differential Geometry of Manifolds- I
MTU-105(C)	Dynamics and continuum Mechanics-I
MTU-106 (Compulsory to all the students)	**Lab Course-I** Programming in C or C++ and Practicals in Numerical Analysis

NOTE:

- Each 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].
- Each Lab course viz. MTU-106, MTU-206, MTU-311 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.
- All these Lab courses and a Project viz. MTU-417 (for 125 marks) are compulsory to all the students.
- Each semester is of 625 marks.
- Total marks for I sem+ II sem+ III sem + IV sem = 2500.
- Total degree is of 2500 Marks, converted in the form of 100 credits CGPA system. 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.
- Project or 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

UNIT 1:

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

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 D_4.

UNIT 2:

Isomorphisms, Definition and Examples, Cayley's Theorem, Properties of Isomorphisms, Automorphisms, Cosets and Lagrange's Theorem, An Application of Cosets to Permutaion Groups, Normal Subgroups, Factor Groups, Application of Factor Groups, 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.

UNIT 3:

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.

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 1 (Pre-requisites)

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.

Unit 2:

Continuous functions, Homeomorphism, The space of continuous functions, connected sets, Completeness, Totally Bounded sets, Complete Metric spaces, Fixed points, completions.

Unit 3:

Compactness, Compact metric space, Uniform continuity, Equivalent Metrics, Discontinuous functions, The Baire category theorem.

Unit 4:

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.

Unit 5 :

Equicontinuity, Continuity and category, The Stone Weierstrass theorem.

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 1:

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.

Unit 2:

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.

Unit 3:

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).

Unit 4:

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.

Unit 5:

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.

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.

Unit II: 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.

Unit III: 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.

Unit IV: 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.

Unit V: 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.

ReferenceBooks:

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 1 :

Introduction: - Level sets and Tangent spaces, Lagrange's multipliers, Maxima & Minima on open sets.

Unit 2 :

Line integral, Frenet-Serret equations, Double Integration parameterized surfaces in R^3. , Surface Area, Surface Integral.

Unit 3 :

Stoke's Theorem, Triple integral, The Divergence theorem.

Unit 4 :

Geometry of surfaces in R^3, Gaussian curvatures, Geodesic curvature.

Tex 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. One parameter group of transformations Lie -derivatives. Immersions and imbedding. Distributions. Exterior algebra. Exterior Derivative.

Unit II: Lie Groups and Lie Algebras:

Topological groups. Lie groups and Lie algebras. Product of two Liegroups. One parameter subgroups and exponential maps.

Examples of Liegroups. Homomorphism and Isomorphism. Lie transformation groups. General linear groups.

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.

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.

Unit III: Newtons Laws of Motion:

Mass, Momentum, Force, Newton's laws of motion, Work, Energy and Power, Conservative forces- potential energy, Impulsive forces.

Unit IV: 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.

Unit V: Introduction to Rigid Body Dynamics:

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,

Unit VI: Two Dimensional Rigid Body Dynamics:

Problems illustrating the laws of motion, Problems illustrating the law of conservation of energy, Problems illustrating the impulsive motion.

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.