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)-Second Semester (CBCS Pattern)

SEMESTER-II								
Sr. No.	**Course**	**Course Title**	**Theory/ Practical Paper**	**No. of Credits**	**Marks@ 25/Credit**	**Internal Component (50%)**	**Semester End Component (50%)**	**Grand Total**
MTU-201	Core I	Linear Algebra	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-202	Core II	Real Analysis-II	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-203	Core III	Topology	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-204	Core IV	Elementary Number Theory	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-205(A)/ (B)/(C)	Elective Group II	Differential Equations/ Differential Geometry of Manifolds- II/ Dynamics and continuum Mechanics-II	**L/T**	**4**	**100**	**50**	**50**	**100**
MTU-206	Core Practical II	Lab Course-II (Software Scilab and Practicals in Linear algebra, Number Theory, Analysis)	**p**	**5**	**125**	**50**	**75**	**125**
		Total						**625**

List of Core/ Elective Subjects to be offered

Core Subjects

1. Linear Algebra
2. Real Analysis-II
3. Topology
4. Elementary Number Theory
5. Lab Course-II (Software Scilab and Practicals in Linear algebra, Number Theory, Analysis)

Elective Subjects

Elective Group (Any one for Second Semester)

1. Differential Equations/
2. Differential Geometry of Manifolds- II
3. Dynamics and continuum Mechanics-II

NOTE:

- Second 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-206 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 II

MTU -201: Linear Algebra

(Maximum Number of Periods: 60)

(Pre-requisites: Basic theory of fields, Field extension, Examples, matrices, determinants, polynomials**.** Elementary Matrix Operations and elementary matrices, the rank of a matrix, System of linear equations-Theoretical Aspects, System of linear equations-Computational Aspects**)**

Unit I: Vector spaces: Introduction, Vector spaces, subspaces, Linear combinations and system of linear equations, linear dependence and independence, Bases and dimension, Maximal Linear Independent Subsets. **(12L+3T)**

Unit II: Linear Transformations and Matrices: Linear Transformations, Null spaces, and ranges, the matrix representation of a linear transformation, Composition of linear transformations, Invertibility and Isomorphisms, The change of Coordinate matrix, Dual spaces, and Homogeneous linear Differential equations with constant coefficients. **(12L+3T)**

Unit III: Diagonalization: Eigen values and eigen vectors, Diagonalizabity, Invariant Subspaces and the Cayley-Hamilton Theorem. **(12L+3T)**

Unit IV: Inner Product Spaces: Inner products and Norms, The Gram-Schmidt orthogonalization process and orthogonal complements, the adjoint of a linear operator, Normal and self-adjoint operators, Unitary and orthogonal operators and their matrices, orthogonal projections and the spectral theorem, Quadratic forms. Jordan Canonical form I, Jordan Canonical form II, The minimal polynomial, Rational Canonical form. **(12L+3T)**

Text Book: S.H.Friedberg, A.J.Insel, L.E.Spence: Linear Algebra, Prentice-Hall International,Inc., 3rd Edition.

Scope: Ch 1: Art.1.1 to 1.7, Ch 2:Art. 2.1 to 2.7, Ch 3:Art 3.1 to 3.4, Ch 5: Art 5.1,5.2,5.4, Ch 6:Art 6.1 to 6.7, Ch 7 : Art 7.1 to 7.4 .

Reference Books:

1. Vivek Sahai, Vikas Bist: Linear Algebra, Narosa Publishing House, 2nd Edition.
1. I. N. Herstein, "Topics in Algebra", Macmillan, Indian Edition.
2. S.Lang:Introduction to Linear algebra,Springer International Edition,2nd Edition.
3. K.Hoffman,R.Kunze: Linear Algebra. Prentice Hall of India.
4. J.H.Kwak, S.Hong: Linear Algebra, Birkhäuser Verlag, 2nd Edition.
5. Harvey E.Rose:Linear Algebra.A pure Mathematical Approach, Birkhäuser Verlag.

MTU-202: REAL ANALYSIS –II
(Maximum Number of Periods: 60)

(Pre-requisites: Algebra of sets, The axiom of choice and infinite direct products, Open and closed sets of real numbers, continuous functions, Borel sets.)

Unit I: Lebesgue measure: Introduction,outer measure, measurable sets and Lebesgue measure, a nonmeasurable set, Measurable functions, Littlewood's three principles. **(12L+3T)**

Unit II: The Lebesgue integral: The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, The integral of a nonnegative function, The general Lebesgue integral, convergence in measure.

(12L+3T)

Unit III : Differentiation and integration : Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolute continuity, convex functions. **(12L+3T)**

Unit IV : Classical Banach spaces: The L^p spaces, The Minkowski and H¨lder inequalities, convergence and completeness. Approximation in L^p .

Measure and Integration: Measure spaces, Measurable functions, Integration, General Convergence Theorems, Signed measures, The Radon-Nikodym Theorem, The L^p spaces.

Text Book: - H. L. Royden: Real Analysis, 3rd Edition, PHI Learning Private Ltd.

Scope: - Chapter 1: Art.4 & 5, Chapter 2: Art.5,6 & 7,Chapter 3: Art.1 to 6,Chapter 4: Art.1 to 5,Chapter 5: Art.1 to 5,Chapter 6: Art.1 to 5, Chapter 11: Art.1 to 7.

Reference Books:

1 N.L. Carothers, “Real Analysis”, Cambridge university press.
2 P.R. Halmos: Measure theory, Narosa Publishing House.
3 Inder K.Rana : An Introduction to measure and Integration. Norosa publishing House ,Delhi : 1997.
4 G. de. Barra; Measure theory and Integration,
5 P.K. Jain and V.P Gupta : Lebesgue measure and Integrtion , New age international (P) ltd publishing, New Delhi (Reprint 2000.)

MTU-203: TOPOLOGY

(Maximum Number of Periods: 60)

Unit I: Topological Spaces, Basis for Topology, The Order Topology, The product Topology, The Subspace Topology , Closed Sets and Limit Points , Continuous functions , The Metric Topology. **(12L+3T)**

Unit II: Connectedness: Connected Spaces, Connected Subspace on Real Line, **(12L+3T)**

Unit III: Compactness: Compact Spaces, Compact Subspace on the Real Line, Limit Point Compactness, Local Compactness. **(12L+3T)**

Unit IV: Countability and Separation Axioms: The Countailibity Axioms, the Separation Axioms, Normal Spaces, the Urysohn's Lemma, The Urysohan Metrization Theorem, the Tietze Extension Theorem, the Tychonoff Theorem. **(12L+3T)**

. ***Text Book:***

James R. Munkres: Topology, A first course, Prentice Hall of India. Pvt. Ltd. New Delhi-2000.

Scope:-

Chapter 2: Articles 12 to 20
Chapter 3 : Articles 23, 24, 26, 27,28, 29
Chapter 4: Articles 30 to 35.
Chapter 5: Articles 37

Reference Books:

i] J. Dugundji Allya and Bacon. Topology, (1966) reprinted: Prentice Hall of India.

ii] W. J. Pervin: Foundations of general topology, academic press Inc. N.Y. Hi] S. T.Hu: Elements of general topology. Holden day Inc. 1965.

iii] Stephen Willard, "General Topology", Addison-Wesley Publishing Company, 1970

iv] Sheldon W. Davis, Topology (The Walter Rudin Student Series in Advanced Mathematics),TATA McGraw-Hill.2006.

MTU-204: Elementary Number Theory
(Maximum Number of Periods: 60)

Unit I : **Divisibility Theory in the Integers:** Division Algorithm, the Greatest common Divisor, The Euclidean Algorithm, The Diophantine Equations $ax+by = c$, Fundamental Theorem of Arithmetic. **(12L+3T)**

Unit II: **Theory of Congruences:** Basic Properties of Congruences, Binary and Decimal Representations of Integers, Linear congruence and the Chinese Remainder Theorem. **Fermat Theorem:** Fermat Little theorem and Pseudo primes, Wilson's Theorem, The Farmat –Kraitchik Factorization Method , The Equation $x^2+y^2 = z^2$, Fermat's last Theorem. **(12L+3T)**

Unit III: **Euler's Generalization of Fermat's Theorem:** Sum and Number of divisors, The Mobius Inversion Formula, The greatest Integer function, Euler's Phi- Function, Euler's theorem, Properties of Phi function. **(12L+3T)**

Unit IV: **Primitive Roots, Indices and the Quadratic Reciprocity Law:** The Order of an Integer Modulo n , Primitive Roots for Primes , Composite Numbers having primitive Roots, Theory of Indices, Euler's Criterion , The Legendre Symbol and its Properties , Quadratic Congruences with Composite Moduli.

(12L+3T)

Text Book: Elementary Number Theory, By David M. Burton .Tata McGRAW-HILL,2006,

Scope: Chapter 2 to Chapter 9,

Reference Book:

1. A Baker**,** A concise Introduction to the Theory of Numbers, Cambridge University Press 1984
2. J.P. Serre, A course in arithmetic-. GTM Vol.7, Springer Verlag 1973
3. Tom M. Apostol. ,Introduction to Analytic number theory Narosa Publishing house 1980
4. I. Niven and Zuckerman, An Introduction to the Theory of Numbers, 4th Ed Wiley, New York,1980,
5. Rosen K.H., Elementary Number Theory and its Applications Pearson Addision Wesely, 5th Edition.

MTU-205(A): Differential Equations

(Maximum Number of Periods: 60)

(Prerequistes :-The second order homogeneous equation, initial value problems, Linear dependence and independence,A formula for the Wronskian, The homogeneous equation of order n, The non-homogeneous equation of order n.)

Unit I: Initial value problem, solution of the homogeneous equation, Wronskian and linear independence, The Legendre equation, Non-homogeneous equation,The Euler equation, second order equation with regular singular points, The Bessel equation. **(12L+3T)**

Unit II: Equations with variables separated, exact equation, The method of successive approximations, The Lipschitz condition, approximations to and uniqueness of the solutions. Some special equation, complex n-dimensional space, existence and uniqueness of solution to systems, existence and uniqueness of solution for linear systems. **(12L+3T)**

Unit III: First order PDE, Linear equations of first order, Charpit's method, Jacobi method, Quasi-linear equations. **(12L+3T)**

Unit IV: Classification of second order PDE, one dimensional wave equation, Laplace equation, Theory of Green's function for Laplace equation, Heat condensation problem, Duhamel's principle.

(12L+3T)

Textbooks:-

1] E.A.Coddington:"An Introduction to Ordinary Differential Equation", Prentice-Hall of India Pvt.Ltd.New Delhi.

Scope-chapter 1 to 6

2]T.Amarnath:"An elementary course in PDE"(2^{nd} edition), Narosa Publishing House. **Scope**-chapter 1,2

Reference Books:-

1]G.F.Simmons:"Differential Equations with Applications and Historical Notes", (2^{nd} edition)Mc Graw Hill Book Co.

2]W.E.Williams:"Partial Differential Equations",Claredon Press Oxford.

3] G.Birkhoff and G.C.Rota:"Ordinary Differential Equations",John Wiley and Sons.

4]E.T.Copson:"Partial Differential Equations", Cambridge University Press.

5]I.N.Sneddon:"Elements of Partial Differential Equation", Mc Graw Hill Co.