

MATHEMATICS DEPARTMENT
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M.A. (Mathematics) EXTERNAL

Scheme of Teaching and Examination

First Year

Subject Code	Subject	Scheme Of Teaching		
		L	P	Total
401	Measure Theory	4	--	4
402	Complex Analysis	4	--	4
403	Topology	4	--	4
404	Ordinary Differential Equations	4	--	4
405	Graph Theory and Discrete Structure	4	--	4
406	P.D.E and Fourier Analysis	4	--	4
	Total	24	--	24

**DEPARTMENT OF MATHEMATICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

Syllabus to be offered at M. A. Mathematics External First Year w.e.f. June 2014-15

Paper: 401
Real and Functional Analysis

L T P
4-1-0

Prerequisite

The extended real numbers, Borel sets.

Lebesgue measure

Introduction, outer measure, measurable sets and Lebesgue measure, A non measurable sets, measurable function, Littlewoods's three principles.

Lebesgue integral

The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure,

The integral of a non negative function, the general Lebesgue integral, Lebesgue convergence theorem, monotone convergence theorem, Fatau's lemma, generalized Lebesgue convergence theorem

Differentiation and integration

Differentiation of monotone functions, and functions of a bounded variation.

Differentiation of an integral, absolute continuity, convex functions

Metric space:

Metric space, Examples of Metric Space, Completion of metric space.

Normed Spaces and Banach Spaces

Vector Space, Normed Space, Banach Space, Further properties of Normed spaces, Finite Dimensional normed space and subspaces, Compactness and finite dimension, Linear operators, Bounded and continuous liner operators, Linear functional, Linear operators, Bounded and Continuous Linear Operators, Linear functional Linear Operators and

Linear functional on a Finite dimensional spaces, Normed spaces of operators, Dual spaces

Inner Product Spaces, Hilbert Spaces

Inner Product space, Hilbert space, Properties of Inner product Space, Orthogonal compliments and direct sums, Orthonormal sets and sequences, Series related to Orthonormal sequences and sets'

References:

1. H. L. Royden, Real Analysis, Macmillan publication, 1993.
2. E. Kreyszig: Functional Analysis and its application, John Wiley and sons.
3. Walter Rudin, Principles of mathematical analysis, McGraw Hill, 1976.
4. T. M Apostol, Mathematical Analysis, Narosa publishing house, 1985.
5. G.de. Barra, Measure theory and Integration, Wiley Eastern limited 1981.
6. I. P. Natanson, Theory of Functions of real variable, Fredrick Unger pub.1961.
7. B.V. Limaye: Functional Analysis, Wiley Eastern Ltd.
8. G.F. Simmons: Introduction to Topology and Modern Analysis, McGraw - Hill.
9. J.N. Sharma & A Vashistha: Functional Analysis.

**DEPARTMENT OF MATHEMATICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

Syllabus to be offered at M. A. Mathematics External First Year w.e.f. June 2014-15

**Paper: 402
Complex Analysis**

**L T P
4-1-0**

Complex Numbers:

Definition of Complex Numbers, Square roots, Geometric interpolation, rational powers of a Complex Numbers, Topology of the complex plane, Sequence **and** series.

Analytic Functions:

Functions, limits and continuity, differentiability Power series as an analytic function, Exponential and Trigonometric functions, Complex logarithms, Inverse functions, Zeros of analytic functions.

Complex Integration:

Curves in the complex plane, Basic properties of complex Integral, winding number or index of a curve, Cauchy-Goursat Theorem, Homotopy version of Cauchy's theorem, Morea's theorem, Cauchy Integral Formula, Laurent series, The maximum modulus principle.

Singularities:

Isolated and non-isolated singularities, removable singularities poles, singularities at infinity, Analytic continuations.

Calculus of Residues:

Residue at a finite point, residue at a point at infinity, residue theorem, no of zeros and poles, Roaches' theorem,

Residues and evaluation of certain integrals:

Integrals of type $\int_a^{2\pi+a} R(\cos \theta, \sin \theta) d\theta$ integrals of type $\int_{-\infty}^{\infty} f(x) dx$ integrals of

type $\int_{-\infty}^{\infty} g(x) \cos(mx) dx$ singularity in real axes, more on using rectangular curves.

References:

1. S. Ponnuswamy, foundation of complex analysis, Narosa publishing house, 1997.
2. S. Lang, Complex Analysis, Addition Wesley, 1997.
3. J. N. Sharma, Functions of a Complex Variable, Krishna Prakashan, 2000.
4. H. A. priestly, introduction to complex analysis, Clarendon Press, 1990.
5. J. B. Conway, Functions of one complex variable, Springer- Verlag, 1980.

**DEPARTMENT OF MATHEMATICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

Syllabus to be offered at M. A. Mathematics External First Year w.e.f. June 2014-15

Paper: 403
Topology

L T P
4-1-0

I. Fast Revision:

- Sets and functions
- Metric Spaces: Definitions and examples

II. Topological Spaces:

Definitions :

- Topological Space and examples.
- Relative Topology and Examples,
- Continuity & Convergence

Elementary Concepts:

- Open and Closed sets with examples,
- Closure of a set
- Neighborhood of a point, Interior point, limit point, Derived set with theorems and examples

Open Base and Open sub-base:

- Definition and Examples,
- First and second countable spaces with theorems and examples
- Separable spaces with theorems and examples

III. Compactness:

Definitions :

- Cover, Sub-cover, open cover, Basic and sub-basic open cover, sub-cover, countable open cover,
- Continuity and Compactness, with theorems and examples,
- Finite intersection property,
- Heine Borel property with theorems.

Product Spaces:

- Definition and examples,
- Projection mappings and its continuity,
- Open and closed sub-base for product space

Tychonoff's Theorem and Locally Compact Spaces:

- Tychonoff's theorem
- Generalized Heine Borel theorem

Compactness for Metric Spaces:

- Sequentially Compact Metric Space,
- Bolzano Weierstrass Property (BWP),
- Totally bounded Space,
- Ascoli's theorem,

Definitions:

- T_1 and T_2 Spaces with theorems and examples on it
- Regular, completely regular and Normal spaces with their relations and examples & theorems
 - Uryshon's lemma and Tietz's extension theorem

Connected Spaces:

- Definitions and examples,
- Continuity and connectedness
- Disconnected spaces
- Product of connected spaces
- Connectedness of \mathbb{R}^n and \mathbb{C}^n

Component of space:

- Definition and examples
- Theorems and examples on connected spaces

Totally Disconnected Space:

- Definition and examples
- Theorems and examples on totally disconnected spaces

Locally Connected space:

- Definition and examples
- Theorems related to locally connected spaces

References:

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Co., 1963.
2. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Pvt. Ltd.).
4. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
5. J. Hocking and G. Young, Topology, Addison-Wesley, Reading, 1961.

**DEPARTMENT OF MATHEMATICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

Syllabus to be offered at M. A. Mathematics External First Year w.e.f. June 2014-15

Paper :404
Ordinary Differential Equations

L T P 4-1-0

Existence Uniqueness and Continuation of Solutions:

Introduction, Notation and Definitions, Existence and Uniqueness of Solutions of Scalar Differential Equations: General solutions, solution of IVP, Lipschitz condition, Lipschitz constant, Peano's existence theorem, equicontinuous family of functions, Maximal and Minimal solutions, continuation of solution, Differential and Integral Inequalities. Existence Theorems for System of Differential Equations: Lipschitz constant for System of Differential Equations, Picard-Lindelof theorem, Peano's existence theorem, Differential and Integral Inequalities.

Linear Systems:

Introduction: Preliminaries and basic results, construction of T and T^{-1} , Properties of Linear Homogeneous Systems: Definitions, corollary, Abel-Liouville formula, Adjoint systems, Periodic Linear Systems, Floquet's theorem, monodromy matrix, characteristic multipliers, characteristic exponents, Mathieu equation, Application-1 n th Order Linear Homogeneous Equation with variable coefficients, Application-2 n th Order Linear Homogeneous Equation with constant coefficients, Inhomogeneous Linear Systems: Application-1 n th Order Linear Non-homogeneous Equation with variable coefficients, Application-2 n th Order Linear Non-homogeneous Equation with constant coefficients, Behavior of Solutions of n th Order Linear Homogeneous Equations. Asymptotic Behavior.

Stability of Linear and Weakly Nonlinear Systems:

Introduction, Continuous Dependence and Stability Properties of Solutions: Definitions of stability, Examples on stability, Theorems on stability, Linear Systems: Definitions Theorems, corollary, examples on linear systems, Weakly Nonlinear systems, Two dimensional systems: equilibrium point, critical point, phase space, phase portraits, two-dimensional linear autonomous systems, nonzero roots with different and same sign, one root is zero and other is nonzero, Linearly dependent characteristic vectors, Linearly independent characteristic vectors, complex conjugate roots.

Second Order Differential Equations:

Introduction, Preliminary Results, normal form, Riccati equation, General Riccati equation, equations of the form $u'' + a(t)u = 0$, $u'' + (1+b(t))u = 0$, $u'' + (1+b(t)+c(t))u = 0$, Boundedness of Solutions: L^2 -Boundedness, Cauchy-Schwartz inequality, boundedness of $\|u\|$ and $\|u'\|$, Application to Some Classical Equations.

References:

- [1] Shair Ahmad and M Rama Mohana Rao, Theory of Ordinary Differential Equations, Affiliated East-West Press Pvt. Ltd., New Delhi, 1999.
- [2] P. Hartman, Ordinary Differential Equations, John Wiley, 1964.
- [3] W. T. Reid, Ordinary Differential Equations, John Wiley, New York, 1971.
- [4] E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, McGraw Hill, NY, 1955.

**DEPARTMENT OF MATHEMATICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

Syllabus to be offered at M. A. Mathematics External First Year w.e.f. June 2014-15

Paper :405

Graph Theory and Discrete structure

L T P

4-1-0

Graph-Paths-Circuits

What is Graph?, Application of Graphs, Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendent Vertex, and Null Graph, Isomorphism, Subgraphs, Walks Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Operations on Graphs, More on Euler Graphs, Hamiltonian Paths and Circuits, The Traveling Salesman Problems.

Trees and Fundamentals Circuits :

Trees, Some Properties of Trees, Pendant vertices in a tree, Distance and Centers in a tree, Rooted and Binary Trees, On counting trees, Spanning trees, Fundamentals circuits, Finding all spanning Trees of a Graph, Spanning Trees in a Weighted Graph.

Cut-Sets and Cut-Vertices and Planar and Dual Graphs :

Cut-Sets, Some Properties of a Cut-Set, All Cut-Sets in a Graph, Fundamental Circuits and Cut-Sets, Connectivity and Separability, Planar Graphs, Kuratowski's Two Graphs, Different Representations of a Planar Graph, Detection of Planarity.

Matrix Representation of Graphs :

Incidence matrix, Submatrices of $A(G)$, Circuits Matrix, Fundamental Circuit Matrix and Rank of B , An Application to a Switching Network, Cut-Set Matrix, Relationships among A_f , B_f , and C_f , Path Matrix, Adjacency Matrix.

Algebraic Structures:

Algebraic systems, Examples and General Properties, Definition and Examples, Some Simple Algebraic Systems and General Properties, Semigroups and Monoids, Definitions and Examples, Homomorphism of Semigroups and Monoids, Subsemigroups and Submonoids, Grammars and Languages, Discussion of Grammars, Formal Definition of a Language, Notions of Syntax Analysis, Polish Expression and Their Compilation, Polish Notation, Conversion of Infix Expression to Polish Notation, The Application of Residue Arithmetic to Computers, Introduction to Number Systems, Residue Arithmetic, Group Codes, The Communication Model and Basic Notions Error Correction, Generation of Codes by Using parity Checks, Error Recovery in Group Codes,

Lattices and Boolean Algebra:

Lattices 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, Representation and Minimization of Boolean Functions, Representation of Boolean Functions,

References:

1. Narsing Deo : Graph Theory, PHI, 1993.
2. Tremblay and Manohar : Discrete Mathematics Structures with Applications to Computer Science, Tata McGraw-Hill, 2008
3. B. Stayanarayan : Discrete Mathematics & Graph Theory,
And K.S.Prasad PHI, (2009)
3. R. Manohar & Trembtey J.P. : Discrete Mathematical Structure with
application to computer science, TMH, 1999
4. Wilson R.J. : Introduction to G.T. (3rd ed.) Longmann, 1984
5. Gibbons A. : Algorithmic Graph Theory, Cambridge
University Press, 1984
6. Harry F. : Graph Theory, Narosa Publication, 1995
7. Richard J. : Discrete Mathematics, Pearson Educations,
Asia, 2001

**DEPARTMENT OF MATHEMATICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

Syllabus to be offered at M. A. Mathematics External First Year w.e.f. June 2014-15

**Paper :406
P.D. E. and Fourier Analysis**

L T P 4-1-0

Ordinary Differential Equations in More than Two Variables...

Surfaces and Curves in Three Dimensions, Simultaneous Differential Equations of the First Order and the Degree in Three Variables, Methods of Solutions of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Orthogonal Trajectories of a Systems of a Curves on a Surface, Pfaffian Differential Forms and Equations, Solution of Pfaffian Differential Equations in Three Variables

Partial Differential Equations of the First Order

Partial Differential Equations, Origins of First-Order Partial Differential Equations, Linear Equations of the First Order, Integral Surfaces Passing through a Given Curve, Surfaces Orthogonal to a Given System of Surfaces, Nonlinear Partial Differential Equations of the First Order, Compatible Systems of First-order Equations, Charpit's Method, Special Types of First-order Equations, Solutions Satisfying Given Conditions, Jacobi's Method,

Partial Differential Equations of the Second Order

Linear Partial Differential Equations with Constant Coefficients, Equations with Variable Coefficients, Separation of Variables, Nonlinear Equations of the Second Order.

- Periodic Functions. Trigonometric Series.
- Computation of Fourier series, in various Interval.
- Convergence Theorems for Fourier series.
- Uniform Convergence of Fourier series.
- Functions of any Period $p = 2L$.
- Even and Odd Functions. Half-Range Expansions.
- Complex Fourier series.
- Forced Oscillations.
- Approximation by Trigonometric Polynomial.
- Fourier Integrals.
- Fourier cosine and Sine Transforms.
- Modeling: Vibrating String. Wave Equations.
- Separation of Variables. Use of Fourier Series.

References:

PDE

1. Sneddon I.A. : Elements of Partial Differential Equations, McGraw Hill,

- Intonation Edition, 1957
2. Zafar Hasan : Differential Equations and their applications, Second Edition, PHI, 2009.
 3. Iyengar S.N. :Differential Equations, Anmol Publications, 2000
 4. Sharma Gupta : Differential Equations, Krishna Prakashan Media, 1997- 98.
 5. Copson E.T. : Partial Differential Equations, S.-Chand & Co. Pvt. Ltd., 1976

Fourier Analysis

- 1.**Kreyszig** : Advanced engineering Mathematics, John Wiley & Sons, 1999
- 2.**Albert Boggess and Francis j. Narcowich** : A First Course in Wavelets with Fourier Analysis 2nd ed., WileyPublication, 2009.
- 3.**Jain, Iyenger** : Advanced Engineering mathematics, Wiley India.
- 4.**Carslaw** : Introduction to Fourier series & Fourier Integrals, CRC Press.