



MANONMANIAM SUNDARANAR UNIVERISTY,
TIRUNELVELI-12

SYLLABUS

UG - COURSES – AFFILIATED COLLEGES

Course Structure for M. Sc. Mathematics

(Choice Based Credit System)

(with effect from the academic year 2024-2025 onwards)



Semester-I				
Part	Subject Status	Subject Title	Subject Code	Credit
III	CORE I	GROUP THEORY	VMAC11	5
III	CORE II	REAL ANALYSIS	VMAC12	5
III	CORE III	ORDINARY DIFFERENTIAL EQUATIONS	VMAC13	4
III	ELECTIVE I	GRAPH THEORY AND APPLICATIONS	VMAE11	3
III	ELECTIVE II	ANALYTIC NUMBER THEORY	VMAE15	3



Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks

A. Scheme for internal Assessment:

Maximum marks for written test: **20 marks**

3 internal tests, each of **1 hour** duration shall be conducted every semester.

To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks.

The break up for internal assessment shall be:

Written test- 20 marks; Assignment -5 marks Total - 25 marks

B. Scheme of External Examination

3 hrs. examination at the end of the semester

A – Part : 1 mark question two - from each unit

B – Part : 5 marks question one - from each unit

C – Part : 8 marks question one - from each unit

➤ **Conversion of Marks into Grade Points and Letter Grades**

S.No	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	AA	-	Absent

➤ **Cumulative Grade Point Average (CGPA)**

$$CGPA = \frac{\Sigma (GP \times C)}{\Sigma C}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

➤ **Classification**

- First Class with Distinction : CGPA \geq 7.5*
- First Class : CGPA \geq 6.0
- Second Class : CGPA \geq 5.0 and $<$ 6.0
- Third Class : CGPA $<$ 5.0



GROUP THEORY

Objectives of the Course

- To introduce the concepts and to develop working knowledge on class equation, solvability of groups and finite abelian groups

UNIT I

A Counting Principle-Normal Subgroups and Quotient Groups- Homomorphisms .

Sections: 2.5-2.7.

UNIT II

Automorphisms - Cayley's Theorem- Solvable Groups.

Sections:2.8,2.9. Supplementary Problems:10-17

UNIT III

Permutation Groups-Another Counting Principle.

Sections:2.10,2.11.

UNIT IV

Sylow's Theorems.

Sections:2.12.

UNIT V

Direct Products –Finite Abelian Groups.

Sections: 2.13,2.14

Recommended Text

- I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Reference Books

- M.Artin, Algebra, Prentice Hall of India, 1991.
- P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
- I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999
- D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.
- N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

Website and e-Learning Source

- <http://mathforum.org>, <http://ocw.mit.edu/ocwweb/Mathematics>,
- <http://www.opensource.org>, www.algebra.com



REAL ANALYSIS - I

Objectives of the Course

- To work comfortably with functions of bounded variation, Riemann- Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.

UNIT-I

Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on $[a, x]$ as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Chapter – 6 : Sections 6.1 to 6.8

Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18

UNIT-II

The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Monotonically increasing integrators, Upper and lower integrals – Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.

Chapter - 7 : Sections 7.1 to 7.6, 7.11- 7.14

UNIT-III

The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable – Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter.

Chapter - 7 : Sections 7.15 to 7.23

UNIT-IV

Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products.

Chapter - 8 : Sections 8.20, 8.21 to 8.26

Power series - Multiplication of power series - The Taylor's series generated by a



function - Bernstein's theorem

Chapter 9 : Sections 9.14 9.15, 9.19, 9.20

UNIT-V

Sequences of Functions – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions – Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann – Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Chapter - 9: Sections 9.1 to 9.6, 9.9, 9.10, 9.11.

Recommended Text

1. Tom M.Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Reference Books

1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc., 1976.
2. Rudin, W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik S.C. and Savita Arora, Mathematical Analysis, Wiley Eastern Limited, New Delhi, 1991.
4. Sanjay Arora and Bansilal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.
6. A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003.

Website and e-Learning Source

1. <http://mathforum.org>, <http://ocw.mit.edu/ocwweb/Mathematics>,
2. <http://www.opensource.org>, www.mathpages.com

ORDINARY DIFFERENTIAL EQUATIONS

Objectives of the Course

- To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations

UNIT-I

Linear equations with constant coefficients: Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Nonhomogeneous equation of order two.

Chapter 2: Sections 1 to 6



UNIT-II

Linear equations with constant coefficients: Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

Chapter 2 : Sections 7 to 12.

UNIT-III

Linear equation with variable coefficients: Initial value problems -Existence and uniqueness theorems – Solutions to solve a nonhomogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Chapter : 3 Sections 1 to 8

UNIT-IV

Linear equation with regular singular points: Euler equation – Second order equations with regular singular points – Bessel Function.

Chapter 4 : Sections 1 to 4 and 7, 8

UNIT-V

Existence and uniqueness of solutions to first order equations: Equation with variable separation – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Chapter 5 : Sections 1 to 6

Recommended Text

1. E.A. Coddington, An introduction to ordinary differential equations (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.

Reference Books

1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

Website and e-Learning Source

1. <http://mathforum.org>, <http://ocw.mit.edu/ocwweb/Mathematics>,
2. <http://www.opensource.org>, www.mathpages.com



GRAPH THEORY AND APPLICATIONS

Objectives of the Course

- To understand and apply the fundamental concepts in Graph Theory, to apply Graph Theory based tools in solving practical problems and to improve the proof writing skills.

UNIT-I

Basic Result: Subgraphs – Degrees of Vertices – Paths and Connectedness – Automorphism of a simple graph – Line graphs – Operations on graphs – Graph Products.

Chapter 1: Sec 1.1 to 1.9.

UNIT-II

Connectivity: Vertex Cuts and Edge Cuts – Connectivity and Edge Connectivity – Blocks.

Chapter 3: Sec 3.1 to 3.4.

UNIT-III

Trees: Definition, Characterization and simple properties - Centres and centroids - counting the number of Spanning Trees -Cayley's formula

Chapter 4: Sec 4.1 to 4.5.

UNIT-IV

Independent Sets and Matchings: Vertex – Independent Sets and Vertex Coverings – Edge Independent Sets – Matchings and Factors – Matching in Bipartite Graphs – Perfect Matching and the Tutte Matrix

Chapter 5: Sec 5.1 to 5.6.

UNIT-V

Eulerian and Hamiltonian Graphs: Eulerian Graphs- Hamiltonian Graphs- Hamilton's "Around the World" Game Graph Colorings: Vertex colorings- Applications of Graph Colorings- Critical Graphs-Brooks' Theorem.

Chapter 6: Sec 6.1 to 6.3,

Chapter 7: Sec 7.1 to 7.3 (up to Brooks theorem).

Recommended Text

- R.Balakrishnan and K.Ranganathan, TextBook of Graph Theory, Springer Publications, 2012.

Reference Books

- H.J.A Bondy and U.S.R.Murty. Graph Theory with Applications. North Holland, New York, Amsterdam, Oxford, 2008.



2. West, D. B., Introduction to Graph Theory, Pearson Education, 2011.
3. Robin J. Wilson, Graph Theory, Pearson Education, Asia 2002.
4. P.J. Cameron, J. H. Van Lint, Graph Theory, Coding Theory and Block Designs, London Mathematical Society Lecture Note Series (19), Cambridge University Press, Reprint in April 2013.
5. Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill, 2007

ANALYTIC NUMBER THEORY

Objectives of the Course

- To understand Dirichlet multiplication, a concept which helps clarify interrelationship between various arithmetical functions and also some equivalent forms of the prime number theorem.

UNIT-I : The Fundamental Theorem of Arithmetic.

Chapter 1 : Section 1.1 - 1.8

Exercise Problems :Chapter 1 : 1 - 11.

UNIT-II : Arithmetic Functions.

Chapter 2: Sections 2.1 - 2.8.

Exercise problems:Chapter 2: 1 - 6.

UNIT-III : Multiplicative Functions and Dirichlet Multiplication.

Chapter 2: Sections 2.9 – 2.14.

Exercise problems: Chapter 2: 21 - 23, 25, 26.

UNIT-IV : Averages of Arithmetical Functions.

Chapter 3: Sections 3.1 - 3. 9.

Exercise problems: Chapter 3: 1 - 4.

UNIT-V: Partial sums of Dirichlet Product, Chebyshev's Functions – Equivalent forms of Prime Number Theorem.

Chapter 3: Sections: 3.10, 3.11, Chapter 4: Sections 4.1 – 4.4.

Exercise problems: Chapter 4: 3, 4, 5, 8.

Recommended Text

1. Introduction to Analytic Number Theory – Tom M. Apostol - Springer, International Student Edition.

Reference Books

1. Problems in Analytic Number Theory, M. Ram Murty, Springer(2001)
2. Steps into Analytic Number Theory, Paul Pollack, Akash Singha Roy, Springer (2021)

