MANONMANIAM SUNDARANAR UNIVERSITY – TIRUNELVELI

PG **PROGRAMMES**

**OPEN AND DISTANCE LEARNING(ODL) PROGRAMMES**

**(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023–2024)**

**M.Sc. Mathematics**

| Semester | Course | Title of the Course | Course Code | Course Type |
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| I | Core I | Algebraic Structures | SMAM11 | Theory |
| | Core II | Real Analysis-I | SMAM12 | Theory |
| | Core III | Ordinary Differential Equations | SMAM13 | Theory |
| | Elective-I | Graph Theory and Applications | SMAE11 | Theory |
| | Elective-II | Fuzzy Sets and their Applications | SMAE12 | Theory |

## 1. ALGEBRAIC STRUCTURES

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| **UNIT-I :** Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proofonly).<br>Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5) |
| **UNIT-II :** Solvable groups - Direct products - Finite abelian groups-Modules<br>Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1), Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)<br>Chapter 4: Section 4.5 |
| **UNIT-III :** Linear Transformations: Canonical forms –Triangularform - Nilpotent transformations.<br>Chapter 6: Sections 6.4, 6.5 |

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| **UNIT-IV :** Jordan form - rational canonical form.<br>Chapter 6 : Sections 6.6 and 6.7 |
| **UNIT-V:** Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.<br>Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9) |
| **Recommended Text :**<br><br>I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975. |

## 2. REAL ANALYSIS – I

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| **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.<br>Chapter – 6 : Sections 6.1 to 6.8<br>**Infinite Series :** Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.<br>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.<br>Chapter - 7 : Sections 7.1 to 7.6, 7.11- 7.14 |
| **UNIT-III : The Riemann-Stieltjes Integral** - Integrators of boundedvariation-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.<br>Chapter - 7 : Sections 7.15 to 7.23 |

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| **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.<br>Chapter - 8 : Sections 8.20, 8.21 to 8.26<br>**Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem<br>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.<br>Chapter - 9: Sections 9.1 to 9.6, 9.9, 9.10, 9.11. |
| **Recommended Text :**<br><br>Tom M.Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. |

**3.ORDINARY DIFFERENTIAL EQUATIONS**

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| **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.<br>Chapter 2: Sections 1 to 6 |
| **UNIT-II : Linear equations with constant coefficients:** Homogeneous and non-homogeneous equation of order n –Initial valueproblems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.<br>Chapter 2 : Sections 7 to 12. |
| **UNIT-III : Linear equation with variable coefficients:** Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.<br>Chapter : 3 Sections 1 to 8 ( Omit section 9) |

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| **UNIT-IV :Linear equation with regular singular points:** Eulerequation – Second order equations with regular singular points<br>–Exceptional cases – Bessel Function.<br>Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9) |
| **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.<br>Chapter 5 : Sections 1 to 6 ( Omit Sections 7 to 9) |
| **Recommended Text**<br><br>E.A.Coddington, *A introduction to ordinary differential equations* ($3^{rd}$ Printing) Prentice-Hall of India Ltd., New Delhi, 1987. |

**4.GRAPH THEORY AND APPLICATIONS**

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| **UNIT-I : Basic Result:** Subgraphs – Degrees of Vertices – Paths and Connectedness – Automorphism of a simple graph – Line graphs – Operations on graphs – Graph Products.<br>Chapter 1: Sec 1.1 to 1.9. |
| **UNIT-II :Connectivity:** Vertex Cuts and Edge Cuts – Connectivityand Edge Connectivity – Blocks.<br>Chapter 3: Sec 3.1 to 3.4. |
| **UNIT-III : Trees:** Definition, Characterization and simple properties - Centres and centroids - counting the numer of Spanning Trees -Cayley's formula<br>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 Bi-partite Graphs – Perfect Matching and the Tutte Matrix<br>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.<br>Chapter 6: Sec 6.1 to 6.3,<br>Chapter 7: Sec 7.1 to 7.3 (up to Brooks theorem). |
| **Recommended Text :**<br>R.Balakrishnan and K.Ranganathan, *TextBook of Graph Theory*, Springer Publications, 2012. |

## 5. FUZZY SETS AND THEIR APPLICATIONS

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| **UNIT-I :** Fundamental Notions. Chapter I: Sec. 1 to 8 |
| **UNIT-II :** Fuzzy Graphs. Chapter II: Sec. 10 to 18 |
| **UNIT-III :** Fuzzy Relations. Chapter II: Sec. 19 to 29 |
| **UNIT-IV:**Fuzzy Logic. Chapter III:Sec.31 to 40(omit Sec.37,38, 41) |
| **UNIT-V:** The Laws of Fuzzy Composition. Chapter IV: Sec.43 to 49 |
| **Recommended Text :**<br>A.Kaufman, *Introduction to the theory of Fuzzy subsets*, Vol.I, Academic Press, New York, (1975). |