

MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI
PG - COURSES – AFFILIATED COLLEGES
 Course Structure for M.Sc Mathematics
 (Choice Based Credit System)
 (with effect from the academic year 2016- 2017 onwards)
 (44th SCAA meeting held on 30.05.2016)

Sem	Sub 'Pr. No.	Subject status	Subject Title	Hrs/ week	Cre - dits	Marks				
						Maximum			Passing minimum	
						Int.	Ext	Tot.	Ext.	Tot
III	9	Core – 7	Measure and Integration	8	6	25	75	100	38	50
	10	Core – 8	Topology	8	6	25	75	100	38	50
	11	Core – 9	Research Methodology	7	5	25	75	100	38	50
	12	Elective—III (Choose any one)	a.Partial Differential Equations b. Operations Research c.Wavelets	7	5	25	75	100	38	50
IV	13	Core – 10	Functional Analysis	8	6	25	75	100	38	50
	14	Core – 11	Complex Analysis	8	6	25	75	100	38	50
	15	Core - 12	Differential Geometry	8	6	25	75	100	38	50
	16	Project	Project	6	4	50	50	100	25	50

Measure and Integration

Unit I : Lebesgue Measure – Lebesgue Outer Measure – The σ - Algebra of Lebesgue Measurable sets – Outer and Inner Approximation of Lebesgue Measurable sets – Countable Additivity, Continuity and the Borel – Cantelli Lemma – Lebesgue Measurable functions – Sums, Products and Compositions.

Chapter 2 : Sec 2.1 – 2.5 and **Chapter 3 :** Sec 3.1

Problems : **Chapter 2 :** 1 – 12, 16 – 18 and **Chapter 3 :** 1 – 6

Unit II : Sequential pointwise Limits and Simple Approximation – Littlewood’s Three Principles, Egoroff’s Theorem and Lusin’s Theorem – Lebesgue Integration – The Riemann Integral – The Lebesgue Integral of a bounded Measurable function over a set of finite Measure – The Lebesgue Integral of a Measurable non – negative function – The general Lebesgue Integral – Countable Additivity and Continuity of Integration.

Chapter 3 : Sec 3.2 & 3.3 and **Chapter 4 :** Sec 4.1 – 4.5

Problems : **Chapter 4 :** 9 – 12, 16 – 20, 28, 30

Unit III : Differentiation and Integration – Continuity of monotone functions – Differentiability of monotone function : Lebesgue theorem – Functions of bounded variations : Jordan’s theorem – Absolutely continuous functions – Integrating Derivatives : Differentiating Indefinite Integrals.

Chapter 6 : Sec : 6.1 – 6.5 (**No problems**)

Unit IV : Measure and Integration – Measures and Measurable sets – Signed Measures : The Hahn and Jordan Decompositions.

Chapter 17 : Sec : 17.1 – 17.4

Problems : **Chapter 17 :** 1, 2, 5, 13, 14, 18 & 19

Unit V : Integration over general Measure spaces : Measurable Functions – Integration of non – negative Measurable functions – Integration of general Measurable function (Upto the Lebesgue Dominated Convergence theorem only).

Chapter 18 : Sec : 18.1 – 18.3

Problems : **Chapter 18 :** 1, 2, 4, 5, 6, 19, 21, 31, 32

Text Book : Real Analysis, Fourth Edition, H.L.Royden, P.M.Fitzpatrick, PHI Learning Private Ltd.

Topology

- Unit I :** Topological Spaces – Closed sets and limit points.
Chapter 2 : Sec : 12 – 17.
Problems : **Chapter 2 :** Sec 13 : All Exercise Problems,
Sec 16 : 1 – 6, Sec 17 : 1 – 16.
- Unit II :** Continuous Functions – Product Topology – Connected Spaces.
Chapter 2 : Sec : 18, 19, 23.
Problems : **Chapter 2 :** Sec 18 : 1 – 6, Sec 19 : 1 – 4, Sec 23 : 1 – 5.
- Unit III :** Compact Spaces – Local Compactness.
Chapter 3 : Sec : 26, 29.
Problems : **Chapter 3 :** Sec 26 : 1 – 6, Sec 29 : 1 – 3.
- Unit IV :** The Countability Axioms – The Separation Axioms – Normal Spaces.
Chapter 4 : Sec : 30, 31, 32.
Problems : **Chapter 4 :** Sec 30 : 1 – 3, Sec 31 : 1 – 4, Sec 32 : 1 – 4.
- Unit V :** The Urysohn Lemma – The Urysohn Metrization Theorem – The Tietze Extension Theorem.
Chapter 4 : Sec : 33 , 34, 35.
Problems : **Chapter 4 :** Sec 33 : 1 – 4, Sec 35 : 1 – 3.
- Text Book :** **Topology (Second Edition)**, James R Munkres, Prentice Hall of India Pvt. Ltd.

Research Methodology

- Unit I :** Research Project – Difference between a dissertation and a thesis – Basic requirements of a research degree – Writing a proposal – Ethical considerations – Different components of a Research Project – Literature review – Methodology – Results / data – Conclusions – Bibliography - Appendices.
Chapter 5 : Sec : 5.1 – 5.13, **Chapter 6 :** Sec : 6.1 – 6.7, 6.8 (6.8.1 only), 6.9 (6.9.1 only), 6.11, 6.12 (6.12.1 only), 6.13 in Book 1
- Unit II :** Some Special Distributions : The Gamma and Chi – Square distribution – The normal distribution.
Chapter 3 : Sec : 3.3, 3.4 in Book 2.
Exercise Problems : Chapter 3 : 3.28 – 3.35, 3.40 – 3.46, 3.49 – 3.54.
- Unit III :** Sampling Theory : Transformation of variables – t & F distributions.
Chapter 4 : Sec : 4.1 – 4.4 in Book 2.
Exercise Problems : Chapter 4 : 4.1 – 4.8, 4.14 – 4.17, 4.20 – 4.25, 4.34 – 4.41.
- Unit IV :** Change of variable technique – The MGF technique – Distributions of \bar{X} and $\frac{ns^2}{\sigma^2}$ - Expectations of functions of random variables.
Chapter 4 : Sec : 4.5 – 4.9 in Book 2.
Exercise Problems : Chapter 4 : 4.42, 4.43, 4.50, 4.51, 4.68 – 4.74, 4.83 – 4.93.
- Unit V :** Limiting distributions, Stochastic, Convergence – Limiting moment generating functions – The Central Limit Theorem – Some theorems on Limiting Distributions.
Chapter 5 : Sec : 5.1 – 5.5 in Book 2.
Exercise Problems : Chapter 5 : 5.1 – 5.3, 5.7, 5.8, 5.11 – 5.13, 5.15, 5.16, 5.20 – 5.27, 5.30 – 5.35.
- Text Book :** **1. Writing up your University Assignments and Research Projects – A Practical handbook**, Neil Murray and Geraldine Hughes, McGraw Hill Open University Press.
- 2. Introduction to Mathematical Statistics**, Fourth Edition, Robert V. Hogg and Allen T.Craig, Pearson Education Asia.

Partial Differential Equations

Unit I : Simultaneous DE of First Order and First Degree in 3 variables – Methods of solutions of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ - Orthogonal Trajectories of a system of curves on a surface – Pfaffian Differential Forms and equations – Solution of a Pfaffian DE in 3 variables.

Chapter 1 : Sec : 2 – 6. (all problems).

Unit II : Partial DE – Origin of First Order PDE – Linear equations of First Order – Integral surfaces passing through a given curve – Surfaces orthogonal to a given system of surfaces.

Chapter 2 : Sec : 1, 2, 4, 5, 6. (all problems).

Unit III : Cauchy's method of characteristics – Compatible systems of First Order equations – Charpit's Method – Special types of First Order equations.

Chapter 2 : Sec : 8, 9, 10, 11. (all problems).

Unit IV : Origin of Second Order equations – Second Order equations in Physics – Linear PDE with constant coefficients.

Chapter 3 : Sec : 1, 2, 4. (all problems).

Unit V : Characteristics of equations in 3 variables – Solution of linear hyperbolic equations – Separation of variables.

Chapter 3 : Sec : 7, 8, 9. (all problems).

Miscellaneous Problems are not included.

Text Book : **Elements of Partial Differential Equations**, I.N. Sneddon, McGraw Hill, New Delhi, 1983.

Operations Research

- Unit I :** **Transportation Models and its variants :** Definition Of The Transportation Model – Non Traditional Transportation Model – Transportation Algorithm – The Assignment Model.
Chapter 5 : Sections 5.1, 5.2, 5.3, 5.4 and **Exercise problems.**
- Unit II :** **Network Analysis :** Network Definitions – Minimal Spanning Tree Algorithm – Shortest Route Problem – Maximum Flow Model – CPM – PERT.
Chapter 6 : Sections 6.2, 6.3, 6.4, 6.5, 6.7 and **Exercise problems.**
- Unit III :** **Integer Linear Programming :** Introduction – Applications – Integer Programming Solutions – Algorithms.
Chapter 9 : Sections 9.1, 9.2, 9.3 and **Exercise problems.**
- Unit IV :** **Inventory Theory :** Basic Elements Of An Inventory Model – Deterministic Models: Single Item Stock Model With And Without Price Breaks – Multiple Items Stock Model With Storage Limitations – Probabilistic Models : Continuous Review Model – Single Period Models.
Chapter 11 : Sections 11.1, 11.2, 11.3, **Chapter 16 :** Sections 16.1, 16.2, 16.3 and **Exercise problems.**
- Unit V :** **Queueing Theory :** Basic Elements Of Queuing Model – Role Of Poisson And Exponential Distributions – Pure Birth And Death Models – Specialised Poisson Queues – (M/G/1) : (GD/ ∞ / ∞)- Pollaczek-Khintchine Formula.
Chapter 17 : Sections 17.2, 17.3, 17.4, 17.6, 17.7 and **Exercise problems.**
- Text Book :** **Operations Research (Sixth Edition) , Hamdy A. Taha,** Prentice Hall Of India Private Limited, New Delhi.

Wavelets

Unit I : Definition and basic properties of the Discrete Fourier Transform – Translation – Invariant Linear Transformation.

Unit II : Construction of Wavelets of Z_n – The First Stage.

Unit III : The Fourier Transform and construction of $L^2(Z)$ – First Stage Wavelets on Z .

Unit IV : $L^2(R)$ and approximation Identities – The Fourier Transform on R .

Unit V : Multi resolution Analysis and Wavelets – Construction of Multi resolution Analysis.

Chapter 2 : Sec : 2.1, 2.2

Chapter 3 : Sec : 3.1

Chapter 4 : Sec : 4.4, 4.5

Chapter 5 : Sec : 5.1 – 5.4

Text Book : **An Introduction to wavelets through Linear Algebra**, Michael W. Frazier, (Springer – Verlag).

Functional Analysis

Unit I : Banach Spaces – Definition and some examples – Continuous linear transformations – The Hahn – Banach Theorem – The Natural imbedding of N in N^{**} .

Chapter 9 : Sec : 46 – 49.

Problems : Chapter 9 : Sec 46 : 1 – 4, Sec 47 : 1 – 7, Sec 48 : 1 – 4, Sec 49 : 1 – 3.

Unit II : The Open Mapping Theorem – The conjugate of an operator – Hilbert Spaces – Definition and some simple properties – Orthogonal Complements.

Chapter 9 : Sec : 50, 51, **Chapter 10 :** Sec : 52, 53

Problems : Chapter 9 : Sec 50 : 1 – 3, Sec 51 : 1 – 3, **Chapter 10 :** Sec 52 : 1, 3, 4, 6, Sec 53 : 1 – 4.

Unit III : Orthonormal Sets – The Conjugate Space H^* - The Adjoint of an operator – Self – Adjoint operators.

Chapter 10 : Sec : 54 – 57.

Problems : Chapter 10 : Sec 54 : 1 – 5, Sec 55 : 1 – 3, Sec 56 : 1 – 4, Sec 57 : 1, 2.

Unit IV : Normal and Unitary Operators – Projections – Finite Dimensional Spectral Theory – Determinants and the Spectrum of an Operator – The Spectral Theorem.

Chapter 10 : Sec : 58, 59, **Chapter 11 :** Sec : 61, 62.

Problems : Chapter 10 : Sec 58 : 1 – 4, Sec 59 : 1 – 4, **Chapter 11 :** Sec 61 : 1, 2, Sec 62 : 1 – 5.

Unit V : General Preliminaries on Banach Algebras – Definition and Some examples – Regular and singular elements – Topological divisors of zero – The Spectrum – The formula for the Spectral radius – The Radical and Semi – simplicity.

Chapter 12 : Sec : 64 – 69.

No Problems.

Text Book : **Introduction to Topology and Modern Analysis**, G.F.Simmons, McGraw Hill International Editions.

Complex Analysis

- Unit I :** Analytic functions – Polynomials – Power series – Conformality.
Chapter 2 : Sec 1 : 1 – 4, Sec 2 : 4, 5, **Chapter 3 :** Sec 2 : 3, 4
Problems : **Chapter 2** – Sec 1.2 : 1 – 7, Sec 1.4 : 1 – 3 &
Chapter 3 – Sec 2.4 : 1 – 6
- Unit II :** Linear transformations – Symmetry – Family of curves – line integrable – line integrable as functions of arc.
Chapter 3 : Sec 3 : 1 – 5, **Chapter 4 :** Sec 1 : 1 – 3.
Problems : **Chapter 3** – Sec 3.1 : 1 – 4, Sec 3.2 : 1 – 3, Sec 3.3 : 1 – 8, Sec 3.5 : 1, 2, 3 & 6 & **Chapter 4** – Sec 1.3 : 1 – 7.
- Unit III :** Cauchy’s theorem for Rectangle – Cauchy’s theorem in a disc, Cauchy’s Integral formula, Index of a point – The integral formula – Higher derivatives.
Chapter 4 : Sec 1 : 4, 5, Sec 2 : 1 – 3
Problems : **Chapter 4** – Sec 2.2 : 1 – 3, Sec 2.3 : 1.
- Unit IV :** Taylor’s Theorem – Zeros and Poles – The local mapping – The maximum principle of Calculus of Residues.
Chapter 4 : Sec 3 : 1 – 4, Sec 5 : 1.
Problems : **Chapter 4** – Sec 3.2 : 1 – 4.
- Unit V :** The Argument Principle – Evaluation of definite integrals – Harmonic functions.
Chapter 4 : Sec 5 : 2, 3, Sec 6 : 1 – 3
Problems : **Chapter 4** – Sec 5.2 : 1 – 3, Sec 5.3 : 1 – 3, Sec 6.2 : 1, 2.
- Text :** Complex Analysis – Lars V.Ahlfors – Tata McGraw Hill (Third Edition)

Differential Geometry

- Unit I :** Definition of a space curve – Arc length – Tangent – Normal and Binormal – Curvature and Torsion.
Chapter 1 : Sec : 1.1 – 1.5.
Problems : Chapter 1 : Miscellaneous Exercise I : 1 – 5.
- Unit II :** Contact between curves and surfaces – Tangent Surface – Involutives and evolutes – Intrinsic equations – Fundamental Existence Theorem for space curves – Helices.
Chapter 1 : Sec : 1.6 – 1.9.
Problems : Chapter 1 : Miscellaneous Exercise I : 8 – 12.
- Unit III :** Definition of a surface – Curves on a surface – Surfaces of revolution – Helicoids – Metric – Direction Coefficients.
Chapter 2 : Sec : 2.1 – 2.6.
Problems : Chapter 2 : Miscellaneous Exercise II : 1 – 4.
- Unit IV :** Families of curves – Normal Property of geodesics – Geodesic Parallels.
Chapter 2 : Sec : 2.7, 2.10 – 2.12, 2.14.
Problems : Chapter 2 : Miscellaneous Exercise II : 6, 7, 8.
- Unit V :** The Second Fundamental form – Principal Curvature – Lines of Curvature – Compact Surfaces whose points are umbilics – Hilbert’s Lemma – Compact surface of constant curvature.
Chapter 2 : Sec : 2.15, **Chapter 3 :** Sec : 3.1 – 3.3 & **Chapter 4 :** Sec : 4.2 – 4.4.
Problems : Miscellaneous Exercise III : 1 – 5.
- Text :** **An Introduction to Differential Geometry**, T.J.Willmore, Oxford University Press, (17th Impression), New Delhi, 2002, (Indian Print).

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Project