MANONMANIAM SUNDARANAR UNIVERISTY,
TIRUNELVELI-12

SYLLABUS

PG - COURSES – AFFILIATED COLLEGES

Course Structure for M. Sc. Mathematics
(Choice Based Credit System)
(with effect from the academic year 2023-2024 onwards)

Semester-II				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
3	Core IV	ADVANCED ALGEBRA		5
3	Core V	REAL ANALYSIS - II		5
3	Core VI	PARTIAL DIFFERENTIAL EQUATIONS		4
3	Elective III	MATHEMATICAL STATISTICS		3
3	Elective IV	OPERATIONS RESEARCH		3
3	SEC – I	MATHEMATICAL DOCUMENTATION USING LATEX		2

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

A. **Scheme for internal Assessment**:
Maximum marks for written test: **15 marks**
3 internal tests, each of **I 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 and Seminar for 5 marks

The break up for internal assessment shall be:
Written test- 15 marks; Assignment -5 marks; Seminar-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.	Percentage of Marks	Letter Grade	Grade Point	Performance
1	90 - 100	O+	10	Outstanding
2	80 - 89	O	9	Excellent
3	70 - 79	A+	8	Very Good
4	60 - 69	A	7	Good
5	55 - 59	B+	6	Above Average
6	50 - 54	B	5	Pass
7	0 - 49	RA	-	ReAppear
8	Absent	AA	-	Absent

➢ Cumulative Grade Point Average (CGPA)

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

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

➢ Classification

a) First Class with Distinction : CGPA $\geq$ 7.5*****
b) First Class : CGPA $\geq$ 6.0
c) Second Class : CGPA $\geq$ 5.0 and $<$ 6.0
d) Third Class : CGPA $<$ 5.0

ADVANCED ALGEBRA

CORE - IV

Objectives of the Course

- To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.

UNIT-I: Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2

UNIT-II: Roots of Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5

UNIT-III: Elements of Galois theory.
Chapter 5: Section 5.6

UNIT-IV: Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

UNIT-V: Solvability by radicals - A theorem of Frobenius – Integral Quaternions and the Four - Square theorem.
Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1), Chapter 7 : Sections 7.3 and 7.4

Recommended Text

1. I.N. Herstein. Topics in Algebra (II Edition) Wiley EasternLimited, New Delhi, 1975.

Reference Books

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

Website and e-Learning Source

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

REAL ANALYSIS - II

Objectives of the Course

- To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.

UNIT-I

Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)

UNIT-II

Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)

UNIT-III

Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem – The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesaro Summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)

UNIT-IV

Multivariable Differential Calculus - Introduction – The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of Rn to R1
Chapter 12 : Section 12.1 to 12.14 (Apostol)

UNIT-V

Implicit Functions and Extremum Problems: Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of several variables-Extremum problems with side conditions.
Chapter 13: Sections 13.1 to 13.7 (Apostol)

Recommended Text

1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
2. Tom M.Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Reference Books

1. Burkill,J.C.The Lebesgue Integral, Cambridge University Press, 1951.
2. Munroe,M.E.Measure and Integration. Addison-Wesley, Mass.1971.
3. Royden,H.L.Real Analysis, Macmillan Pub. Company, New York, 1988.
4. Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York,1979.
5. Malik,S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited. New Delhi, 1991.
6. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.

Website and e-Learning Source

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

PARTIAL DIFFERENTIAL EQUATIONS

CORE - VI

Objectives of the Course

- To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.

UNIT-I

Mathematical Models and Classification of second order equation: Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution
Chapter 2 : Sections 2.1 to 2.6
Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)

UNIT-II

Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.

Chapter 4 : Sections 4.1 to 4.11

UNIT-III

Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations

Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)

UNIT-IV

Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.

Chapter 8 : Sections 8.1 to 8.9

UNIT-V

Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.

Chapter 10 : Section 10.1 to 10.9

Recommended Text

1. TynMyint-U and Lokenath Debnath, Partial Differential Equations for Scientists and Engineers (Third Edition), North Holland, New York, 1987.

Reference Books

1. M.M.Smirnov, Second Order partial Differential Equations, Leningrad, 1964.
2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd., New Delhi, 2001.
5. S, Sankar Rao, Partial Differential Equations, 2nd Edition, Prentice Hall of India, New Delhi. 2004

Website and e-Learning Source

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

MATHEMATICAL STATISTICS

ELECTIVE - III

Objectives of the Course

- To understand mathematical statistics, acquire basic knowledge about various distributions, understand mathematical expectations, marginal and conditional distributions, the gamma and chi-square distributions, the t & F distributions and their applications, moment generating function technique and the Central Limit Theorem.

UNIT-I

The probability set function – Random Variables – Probability density function – Distribution function – Mathematical expectation – Special mathematical expectations – Chebyshev's Inequality.

UNIT-II

Conditional probability – Marginal and conditional distributions – Stochastic independence Some special distributions: The Binomial, Trinomial and Multinomial distributions – The Poisson distribution

UNIT-III

The Gamma and chi-square distributions –The normal distribution – The Bivariate normal distribution. Distributions of functions of random variables –Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the discrete type – Transformations of variables of the continuous type.

UNIT-IV

The β, t and F distributions – Distributions of order statistics – The moment generating function technique. The distributions of χ 2 and nS2/ σ2 – Expectations of functions of random variables.

UNIT-V

Limiting distributions -Stochastic convergence – Limiting moment generating functions – The central limit theorem – Some theorems on limiting distributions.

Recommended Text

1. Robert V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics (fourth edition) Chapter 1,2 (except 1.1,1.2,1.3,1.8 & 2.3), Chapter 3,4 (except 4.5) and Chapter 5.

Reference Books

1. M. Fisz, Probability theory and Mathematical Statistics, John Wiley & sons, New York, 1963.
2. E.J. Dudewiczn and S.N. Mishra, Modern Mathematical Statistics, John Wiley

& sons, New York, 1988.
3. V.N. Rohatgi, An introduction to Probability theory and Mathematical statistics, Wiley Eastern Limited, New Delhi, 1988

OPERATIONS RESEARCH

ELECTIVE - IV

Objectives of the Course

- To analyse different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.

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. 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. Exercise problems.

UNIT-III

Integer Linear Programming: Introduction – Applications –Integer Programming Solutions – Algorithms.

Chapter 9: Sections 9.1, 9.2, 9.3. 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, Exercise problems.

UNIT-V

Queuing 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 - Khintechine Formula.

Chapter 17: Sections 17.2, 17.3, 17.4, 17.6, 17.7. Exercise problems.

Recommended Text

1. Operations Research (Sixth Edition), Hamdy A. Taha, Prentice Hall of India Private Limited, New Delhi.

Reference Books

1. Operations Research, H.K Pathak, Dr. Pradeep K. Joshi and C.Sharma,Shree Shiksha Sahitya Prakashan Publication, Reprint 2022-23.
2. Operations Research: Principles and Applications, Second Edition, G. Srinivasan, Easrern Economy Edition, PHI

MATHEMATICAL DOCUMENTATION USING LaTex

Skill Enhancement Course - I

Objectives of the Course

- To type Mathematical documents in a simple way.

UNIT-I

Introduction - Basics of a Latex file- Text, Symbols and Commands: Command names and arguments – Environments– Declarations – Lengths – Special characters

UNIT-II

Document Layout and Organization: Document class – Page style – Parts of the document – Table of contents

UNIT-III

Displayed Text: Changing font style – Centering and indenting – Lists – Generalized lists Theorem like-declarations

UNIT-IV

Text in Boxes: Boxes - Footnotes and marginal notes. **Tables**: Tabular stops – Tables

UNIT-V

Mathematical Formulas: Mathematical Environment – Main elements of math mode – Mathematical symbols – Additional Elements.

Recommended Text

1. Guide to LaTeX, Helmut Kopka and Patrick W.Daly, Fourth Edition, Addison – Wesley, Pearson Education, 2004.

Reference Books

1. E. Krishnan, LaTeX TUTORIALS — A Primer, Indian TEX Users Group, 2003
2. H. Kopka and P.W. Daly, A Guide to LaTeX, Addison - Wesley, 2003.
3. Martin J. Erickson and Donald Bindner, A Student's Guide to the Study, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011