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-IV				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
3	Core	ADVANCED ALGEBRA - II		5
3	Core	FUNCTIONAL ANALYSIS		4
3	Core	PROJECT WITH VIVA VOCE		7
3	Elective (Choose any one)	DIFFERENTIAL GEOMETRY/ MATHEMATICAL PYTHON – PRACTICAL/ ALGEBRAIC TOPOLOGY		4
3	SEC - 3	INTRODUCTION TO MACHINE LEARNING AND APPLICATIONS/ FINANCIAL MATHEMATICS/ PROGRAMMING IN C++ -PRACTICAL		2
3	Extension Activity /Pollution Awareness/ Literacy / Voluntary Services	REPORT TO BE SUBMITTED TO THE DEPARTMENT EXTERNAL VALUATION REQUIRED		1

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 II

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
Chapter 5: Section 5.1

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: A theorem of Frobenius-Integral Quaternions and the Four- Square theorem.
Chapter 7 : Sections 7.3 and 7.4

Recommended Text

1. I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, 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 & IIHindustan 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

FUNCTIONAL ANALYSIS

Objectives of the Course

To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student's skills and confidence in mathematical analysis and proof techniques.

UNIT-I

Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N**
Chapter 9: Sections 46-49

UNIT-II

The open mapping theorem – The conjugate of an Operator. The definition and some simple properties–Orthogonal complements– Orthonormal sets
Chapter 9:Sections 50 and 51
Chapter 10 : Sections 52-54

UNIT-III

The conjugate space H*-The adjoint of an operator–selfadjoint operators-Normal and unitary operators – Projections.
Chapter10:Section 55-59

UNIT-IV

Finite-Dimensional Spectral Theory: Determinants and the spectrum of an operator – The spectral theorem.
Chapter 11:Sections 61,62

UNIT-V

General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum.
Chapter 12: Sections 64-67

Recommended Text

1. G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.

Reference Books

1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2. B.V. Limaye, Functional Analysis, New Age International,1996.

3. C.Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987.
4. E.Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
5. M.Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.

Website and e-Learning Source

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

PROJECT WITH VIVA VOCE

Learning Objectives

- To assess the student dissertation for the award of degree, jointly by supervisor and one external examiner affiliated to Manonmaniam Sundaranar University .
- To develop confident and empowers student for future career.
- To better prepare students for solving real-world problems and issues while teaching them, encouraging giving additional information related to their topic.
- To developed student interpersonal skills.
- To encourages students to develop a balanced, diverse approach to solving real societal problems, both on their own and in a team

Methods of Evaluation

Internal Evaluation

Dissertation Submission 50 Marks

External Evaluation

Viva Voce Examination 50 Marks

Total 100 Marks

DIFFERENTIAL GEOMETRY

Objectives of the Course

- This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored

UNIT-I

Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.

Chapter I : Sections 1 to 9.

UNIT-II

Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.

Chapter II: Sections 1 to 9.

UNIT-III

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss-Bonnet Theorem – Gaussian curvature surface of constant curvature.

Chapter II: Sections 10 to 18.

UNIT-IV

Non Intrinsic properties of a surface: The second fundamental form- Principal curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.

Chapter III: Sections 1 to 8.

UNIT-V

Differential Geometry of Surfaces: Compact surfaces whose points are umblics-Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Chapter IV : Sections 1 to 8

Reference Books

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Inter science Publishers, 1963.
3. Wilhelm Klingenberg: A Course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe Elementary topics in Differential Geometry, Undergraduate Texts in Mathematics, Springer - Verlag 1979.

Website and e-Learning Source

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

MATHEMATICAL PYTHON - PRACTICAL

Objectives of the Course

- To Apply basic Python and numpy to solve mathematical problems, Graphical representation and manipulation of data using python

LIST OF PRACTICALS IN MATHEMATICAL PYTHON:

1. Find minimum/maximum in a list / guess an integer in given range
2. Distance between two points
3. Find GCD
4. Sum an array of numbers
5. Linear search
6. Binary search.
7. Find the numbers which are divisible by n in a given range
8. Print first n Fibonacci numbers
9. Selection sort
10. Insertion sort
11. Merge sort
12. Count word frequencies
13. Generate adjacency matrix of any graph on n vertices
14. Find degree of vertices from given adjacency matrix of the graph
15. Find odd number in given array/ Replace odd numbers with given integer in the given array
16. Compute multiplication of two 3x3 matrices
17. Compute mean and standard deviation of given array
18. Create a Bar plot/Pie chart for comparing three features.

Recommended Text

1. Allen B.Dowley,Think Python: How to Think Like a Computer Scientist, 2nd Edition.

Reference Books

1. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly, 2nd Edition, 2018.
2. Jake VanderPlas, Python Data Science Hand Book: Essential Tools for working with Data, O'Reilly, 2017.
3. Wesley J. Chun, Core Python Programming, Prentice Hall, 2006.
4. N.Safina Devi and C.Devamanoharan, Algorithmic Problem Solving and Python- A Beginner's Guide, Francidev Publications, 2023.

ALGEBRAIC TOPOLOGY

Objectives of the Course

- To introduce the ideas of Algebraic Topology to other branches of Mathematics

UNIT-I

Homotopy of paths, fundamental group of a topological space, homotopy of maps of topological spaces, contractible and simply connected spaces.
Chapter 9: Sec: 51, 52.

UNIT-II

The Fundamental group of the circle, Path lifting lemma, Retractions and fixed points, Brouwer's fixed- point theorem for the disc, The fundamental Theorem of Algebra.
Chapter 9. Sec: 54 - 56

UNIT-III

Covering spaces, Equivalence of covering spaces, The general lifting lemma, The universal covering space.
Chapter 9 : Sec: 53, Chapter 13: Sec: 79, 80

UNIT-IV

Separation theorems in the plane, Null homotopy lemma, The Jordan separation theorem, A general separation theorem, Homotopy Extension lemma, Borsuk lemma, Invariance of domain.
Chapter 10: Sec: 61, 62

UNIT-V

Applications to Group theory: Covering spaces of a graph, The fundamental group of a graph.
Chapter 14: Sec 83, 84.

Recommended Text

1. James R. Munkres, Topology, Prentice Hall of India, New Delhi, 2002 (2nd Edition).

Reference Books

1. M.K.Agoston, Algebraic topology- A First Course, Marcel Dekker, 1962
2. Satya Deo, Algebraic Topology, Hindustan Book Agency, New Delhi, 2003.
3. M.Greenberg and Harper, Algebraic Topology-A First course, Benjamin/Cummings, 1981.
4. C.F. Maunder, Algebraic topology, Van Nastrand, New York, 1970

INTRODUCTION TO MACHINE LEARNING AND APPLICATIONS

Objectives of the Course

- Develop advanced knowledge in Machine Learning

UNIT-I

Understanding Machine Learning -What Is MachineLearning?

UNIT-II

Defining Big Data- Big Data in Context with Machine Learning - Leveraging the Power of Machine Learning

UNIT-III

Descriptive analytics - Predictive analytics - The Roles of Statistics and Data Mining with Machine Learning

UNIT-IV

Approaches to Machine Learning - Supervised learning -Unsupervised learning - Reinforcement learning

UNIT-V

Neural Networks - Applying machine Learning - Understanding machine Learning Techniques

Recommended Text

1. Judith Hurwitz and Daniel Kirsch, Machine Learning For Dummies, IBM Limited Edition, Wiley, 2018.
2. Ethem Alpaydın "Introduction to Machine Learning Second Edition", The MIT Press Cambridge, Massachusetts, London, England

FINANCIAL MATHEMATICS

Objectives of the Course

- To understand the geometric Brownian motion and Arbitration Theorem

UNIT-I : Probability and Normal Random Variables
UNIT-II : Brownian Motion and Geometric Brownian Motion
UNIT-III : Interest Rate and Present Value Analysis
UNIT-IV :Pricing Contracts via Arbitrage
UNIT-V : The Arbitrage Theorem

Recommended Text

1. Sheldon M. Ross, An Introduction to Mathematical Finance : Options and Other Topics, Second Edition, Cambridge University Press, First published 2002.

Reference Book

1. I.Karatzas and S.E.Shreve, Methods of Mathematical Finance, Springer, 1998.

PROGRAMMIMG IN C++ - PRACTICALS

Objectives of the Course

- To make the students experts in solving mathematical problems through C++ - programming

List of Practical's:

1. Programs to evaluate sin x, cos x, e-x to 0.0001% accuracy.
2. Program to calculate the variance and standard deviation of a set of numbers.
3. Program to find Product of matrices, inverse of a matrix using functions. Macro that obtains largest of three numbers.
4. Define a class of students and prepare a statement containing name, total marks of Ranks (using functions).
5. Program to check whether a number/ string is a palindrome without using the corresponding standard function.
6. Write a program to conversion between polar and rectangle co-ordinates
7. Define a class string and exhibit the use of string manipulations.
8. Write a program to finding area of 2 different shapes
9. Create a class FLOAT that contains one float data. Overload all the four arithmetic.
10. Write a C++ program implement a class 'Complex' of complex numbers. The class could be include member functions to add and subtract two complex numbers.
11. Write a C ++ program to implement a class for complex numbers with add and multiply as member functions. Overload ++ operator to increment a complex number.
12. Write a program in C++ to demonstrate friend function.

Recommended Text

1. E.Balagurusamy, Object Oriented Programming with C++ , 4th Edition, The McGraw- Hill Company, New Delhi, 2008.

Reference Book

1. V.Ravichandran, Programming with C++, Second Edition Tata McGraw- Hill, New Delhi, 2006.

EXTENSION ACTIVITY /POLLUTION AWARENESS/LITERACY/ VOLUNTARY SERVICES

Learning Objectives

- Extension activities concentrates on putting across in an understandable manner new ideas and improved technologies of practical utility to the rural, tribal and urban privileged and underprivileged people.
- Enables students to use the newly acquired knowledge and skills to improve their general standard of living.
- It is a social science that attempts to adopt various strategies of change in the behaviour patterns of people through technological and scientific innovations for the improvement of their standard of living.
- The idea behind the extension work is the coming together for the task of social upliftment.
- Students typically develop leadership and teamwork skills and become more attuned to working amongst populations of varying ethnicity or socio economic status.

Internal Evaluation

Continuous Performance Assessment and Viva Voce 50 Marks

External Evaluation

Extension Activity Report 50 Marks

Total 100 Marks