STELLA MARIS COLLEGE (AUTONOMOUS), CEHNNAI – 600 086

DEPARTMENT OF MATHEMATICS

PROGRAMME DESCRIPTION

The M.Phil. Mathematics Degree programme lays equal emphasis on motivating and training students towards higher education in the discipline and employability. Focusing on quality research exposure, a platform is set with interrelated subjects at an advanced level. The Programme lays emphasis on research activities through specialisation paper and dissertation leading to presentation in conferences. Publication of original work in peer reviewed journals is facilitated by motivated faculty.

TRUTH CHARITY

STELLA MARIS COLLEGE

(AUTONOMOUS), CHENNAI - INDIA

M.Phil. Degree: Branch I – Mathematics
(CHOICE BASED CREDIT SYSTEM)

SYLLABUS

(Effective from the academic year 2019 – 2020)

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086
MASTER OF PHILOSOPHY IN MATHEMATICS

COURSES OF STUDY OFFERED
(Effective from the academic year 2015 - 2016)
CHOICE BASED CREDIT SYSTEM

C-Credit, **L**-Lecture Hours, **T**-Tutorial Hours, **P**- Practical Hours, **Ex**-Exam Hours,
CA- Continuous Assessment Marks, **ES**-End Semester Marks, **M**-Maximum Marks

Subject Code	Title of Course	C	L	T	P	Ex	CA	ES	M
Semester I									
19MT/RC/AA1 05	Advanced Algebra and Analysis	5	5	1	0	3	50	50	100
19MT/RC/TG1 05	Advanced Topology and Geometry	5	5	1	0	3	50	50	100
Semester II									
19MT/RC/DI2 21	Dissertation and Viva Voce	21				-	-	100	100
Specialization									
19MT/RO/AS2 05	Advanced Algebraic Structures	5	5	1	0	3	50	50	100
OR									
19MT/RO/FT2 05	Fuzzy Set Theory, Fuzzy Logic and Applications	5	5	1	0	3	50	50	100
OR									
19MT/RO/AG2 05	Advanced topics in Graph Theory	5	5	1	0	3	50	50	100
OR									
19MT/RO/AF2 05	Advanced topics in Functional Analysis	5	5	1	0	3	50	50	100

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086
M.Phil. DEGREE: BRANCH I - MATHEMATICS

SYLLABUS
(Effective from the academic year 2019-2020)

PAPER - I

ADVANCED ALGEBRA AND ANALYSIS

CODE: 19MT/RC/AA1 05 **CREDITS: 5**
L T P: 5 1 0
TOTAL TEACHING HOURS: 78

OBJECTIVES OF THE COURSE

- To instill in depth knowledge in Algebra
- To instill in depth knowledge in Analysis
- To inculcate research aptitude in Mathematics

Unit 1 **(16 Hours)**

Lattices and Boolean Algebras

1.1 Partially Ordered Sets and Lattices
1.2 Distributivity and Modularity
1.3 The Theorem of Jordan – Holder – Dedekind
1.4 The Lattice of Subspace of a Vector Space
1.5 Fundamental Theorem of Projective Geometry
1.6 Boolean Algebras

Unit 2 **(14 Hours)**

Modules

2.1 Modules and its properties
2.2 Sub Modules and Direct Sums
2.3 R- homomorphisms and Quotient Modules
2.4 $\mathrm{Hom}_R(\oplus M_i, \oplus M_i)$
2.5 Noetherian and Artinian Modules
2.6 Wedderburn – Artin Theorem

Unit 3 **(16 Hours)**

Tensor Products

3.1 Tensor Products
3.2 Module Structure of Tensor Product
3.3 Tensor Product of Homomorphisms
3.4 Tensor Products of Algebras

Positive Borel Measures

3.5 Vector Spaces
3.6 Topological Preliminaries

Unit 4 **(16 Hours)**

Topological Vector Spaces

4.1 Topological Vector Spaces
4.2 Invariance

4.3 Types of Topological Vector Spaces
4.4 Separation Properties
4.5 Linear Mappings
4.6 Metrization
4.7 Seminorms and Local Convexity

Unit 5 **(16 Hours)**

L^p – Spaces
5.1 Jensen's, Holder's and Minkowski's Inequalities
5.2 Approximation by Continuous Functions
Fourier Transforms
5.3 Formal Properties
5.4 The Inversion Theorem
5.5 The Plancherel Theorem

BOOKS FOR STUDY

Bhattacharya, P.B., S.K. Jain and S.R. Nagpal, *Basic Abstract Algebra 2nd ed.* Cambridge University Press, 1997.
Chapter 14 Sec. 1 – 3.3
Chapter 19 Sec. 1 – 3
Chapter 22 Sec. 2 – 5

Nathan Jacobson. *Basic Algebra– I. India* : Hindustan Publishing Corporation , 1974.
Chapter 8 Sec. 8.1-8.5.

Walter Rudin. *Functional Analysis***.** New York: McGraw-Hill Book Company, 1978.
Chapter 1 Sec. 1.6 - 1.18; 1.24 – 1.28; 1.33 – 1.39.

Walter Rudin. *Real and Complex Analysis***.** New York: McGraw-Hill Book Company, 1987.
Chapter 2 pages 33 – 40
Chapter 3 pages 62 – 71 (excluding 3.11)
Chapter 9 pages 178 – 190

BOOKS FOR REFERENCE

Apostol, Tom M., *Mathematical Analysis* (second Edition), New Delhi: Narosa Publishing House Indian Student Edition, 2002.

Richard S. Pierce. *Associative Algebras*. New York: Springer-Verlag, 1982.

Serge Lang. *Algebra Revised 3rd ed.* New York: Springer-Verlag, 2002.

Walter Rudin. *Functional Analysis***.** New York: McGraw-Hill Book Company, 1978.

PATTERN OF ASSESSMENT

Continuous Assessment: Total Marks: 50 Duration: 90 minutes

Section A: 2×8 = 16 (Three questions to be set)

Section B: 2×17 = 34 (Three questions to be set)

Other Components: Total Marks: 50

Seminars

Theorem Writing Technique

End Semester Examination: Total Marks: 100 Duration: 3 Hours

Section A: 5× 8 = 40 (Seven questions to be set without omitting any unit)

Section B: 3×20 = 60 (Five questions to be set without omitting any unit)

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086
M.Phil. DEGREE: BRANCH I – MATHEMATICS

SYLLABUS
(Effective from the academic year 2019-2020)

PAPER – II

ADVANCED TOPOLOGY AND GEOMETRY

CODE: 19MT/RC/TG1 05 **CREDITS: 5**
L T P: 5 1 0
TOTAL TEACHING HOURS: 78

OBJECTIVES OF THE COURSE

- To introduce the concept of algebraic topology
- To introduce the concept of geometry through simplices
- To introduce the area of research in geometry homology

Unit 1 **(18 Hours)**

Fundamental Group and Covering Spaces
1.1 Homotopy
1.2 Fundamental Group

Unit 2 **(16 Hours)**

Fundamental Group and Covering Spaces (Contd.)
2.1 Covering Spaces

Unit 3 **(16 Hours)**

Simplicial Complexes
3.1 Geometry of Simplicial Complexes
3.2 Barycentric Subdivisions
3.3 Simplicial Approximation Theorem

Unit 4 **(14 Hours)**

Manifolds
4.1 Differentiable Manifolds
4.2 Differential Forms
4.3 Related Miscellaneous Facts

Unit 5 **(14 Hours)**

Homology Theory
5.1 Simplicial Homology

BOOK FOR STUDY

Singer, I.M., and J.A. Thorpe, *Lecture Notes on Elementary Topology and Geometry* **.** Reprint 2003, New York: Springer – Verlag, 1967.
Pages: 49 – 94, 109 – 161.

BOOKS FOR REFERENCE

Croom Fred H., *Basic Concepts of Algebraic Topology*. New York: Springer – Verlag, 1978.

Deo Satya, *Algebraic Topology A Primer*. New Delhi: Hindustan Book Agency, 2003.

Lahiri B.K., *A First Course in Algebraic Topology*. New Delhi: Narosa Publishing House, 2000.

Munkres James R., *Topology A First Course*. New Delhi: Prentice Hall of India, 1987.

Muki Sunil and N.Mukunda, *Introduction to Topology, Differential Geometry and Group Theory for Physicists* .New Delhi: Wiley Eastern Ltd, 1990.

PATTERN OF ASSESSMENT

Continuous Assessment: Total Marks: 50 Duration: 90 minutes

Section A: 2×8 = 16 (Three questions to be set)
Section B: 2×17 = 34 (Three questions to be set)

Other Components: Total Marks: 50

Seminars
Theorem Writing Technique

End Semester Examination: Total Marks: 100 Duration: 3 Hours

Section A: 5× 8 = 40 (Seven questions to be set without omitting any unit)
Section B: 3×20 = 60 (Five questions to be set without omitting any unit)

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

M.Phil. DEGREE: BRANCH I – MATHEMATICS

DISSERTATION AND VIVA VOCE

CODE: 19MT/RC/DI2 21 **CREDITS: 21**

Maximum Marks : 100
Dissertation : 75
Viva : 25

Self Learning : 5hrs./week
Total Hours Allotted: 75

The Dissertation shall contain around 50 pages and shall be typed with double spacing. The format for the thesis is as follows:

1. Cover page shall contain
   a. Title of the Dissertation
   b. Dissertation

      Submitted to Stella Maris College (Autonomous)
      Affiliated to the University of Madras
      In partial fulfillment of the requirements
      For the award of the degree of
      Master of Philosophy
      in
      Mathematics

   c. Name of the Candidate
   d. Department of Mathematics
      Stella Maris College (Autonomous)
      Chennai – 600 086
   e. Month, Year

2. The dissertation shall contain
   (a) i. Certificate page
       ii. Declaration (by the candidate) page
       iii. Acknowledgement page
   (b) Content page
   (c) Atleast 3 chapters including an introductory chapter (comprising motivation, basic concepts needed / used in the thesis and outline of the thesis)
   (d) Conclusions / interpretations arrived at may be given at the end of each problem / Each chapter concerned.
   (e) List of figures / list of abbreviations (if needed) shall be given as an appendix.
   (f) Bibliography shall be given in alphabetical / chronological order at the end.

3. Each candidate may prepare 4 copies of the thesis, one copy for her and submit 3 copies to the Head of the Department by the 15^{th} of July, which is also the end of the academic year for her M.Phil. Course.

4. The candidate may be advised that the dissertation will be valued and given credit on the criteria of
   a. Motivation towards the chosen area / formulation of the problem
   b. Methodology - Analysis, logic and reasoning.
   c. Capacity to interpret the results obtained.

5. The Department should certify as follows:

   This is to certify that the dissertation …… submitted in partial fulfillment of the degree of Master of philosophy in Mathematics is the record of work done under my guidance and supervision by …… in the Department of Mathematics, Stella Maris College, Chennai – 86 during the period of her study in the academic year ……..

Sd	Sd
Head of the department	Supervisor

5. Guidelines for Evaluation :

(a) The maximum mark for the dissertation is 100 divided into four components

(i) Style, format and neatness in presentation	15
(ii) Chapterisation, logic and reasoning	10
(iii) Methodology – Analysis and Interpretation	50
(iv) Viva	25

(b) There will be double valuation for the dissertation by the guide and the external examiner who will conduct the viva – voce and a consolidated mark-sheet will be submitted.

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

M.Phil. DEGREE: BRANCH I - MATHEMATICS

SYLLABUS
(Effective from the academic year 2019-2020)

PAPER – III OPTIONAL

ADVANCED ALGEBRAIC STRUCTURES
CODE: 19MT/RO/AS2 05 **CREDITS: 5**

OBJECTIVES OF THE COURSE

- To instill knowledge in advanced Algebraic Structures
- To introduce current trends in algebra leading to research

Unit 1
Projective Modules
1.1 Exact Sequences
1.2 Projective Modules
1.3 Finitely Generated Projective Modules Over Commutative Rings

Unit 2
Injective Modules
2.1 Exact Sequences
2.2 Injective Modules

Unit 3
The Structure of Semisimple Algebras
3.1 Semi Simple Algebras
3.2 Minimal Right Ideals

Unit 4
The Structure of Semisimple Algebras (contd.)
4.1 Simple Algebras
4.2 Matrices of Homomorphisms
4.3 Wedderburn's Structure Theorem
4.4 Maschke's Theorem

Unit 5
Recent Developments in Algebra
5.1 Semigroups
5.2 Groups
5.3 Semirings
5.4 Near rings
5.5 Modules
5.5 Lattices

BOOKS FOR STUDY AND REFERENCE

Luthar I.S.and I.B.S. Passi. *Algebra (Vol.3) Modules***.** New Delhi: Narosa publishing House, 2002

Musili C. *Introduction to Rings and Modules*. New Delhi: Narosa Publishing House, 1994.

Richard S. Pierce. *Associative Algebras*. New York: Springer-Verlag, 1982

PATTERN OF ASSESSMENT

Continuous Assessment: Total Marks: 50 Duration: 90 minutes

Section A: 2×8 = 16 (Three questions to be set)
Section B: 2×17 = 34 (Three questions to be set)

Other Components: Total Marks: 50

Seminars
Theorem Writing Technique

End Semester Examination: Total Marks: 100 Duration: 3 Hours

Section A: 5× 8 = 40 (Seven questions to be set without omitting any unit)
Section B: 3×20 = 60 (Five questions to be set without omitting any unit)

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

M.Phil. DEGREE: BRANCH I - MATHEMATICS

SYLLABUS

(Effective from the academic year 2019-2020)

PAPER – III OPTIONAL

ADVANCED TOPICS IN FUNCTIONAL ANALYSIS

CODE: 19MT/RO/AF2 05 **CREDITS: 5**

OBJECTIVES OF THE COURSE

- To instill in depth knowledge in Functional Analysis
- To introduce advanced concepts in Functional Analysis leading to research

Unit 1

Fundamental concepts

1.1 Finite Dimensional Normed Linear Space
1.2 Topological Notions in a Metric space Examples
1.3 Complete Metric Spaces
1.4 Completion of Various Incomplete Metric Spaces
1.5 Separable Spaces
1.6 Compactness in Metric Spaces

Unit 2

Banach Algebras

2.1 Introduction
2.2 Complex Homomorphisms
2.3 Basic Properties of Spectra
2.4 Symbolic Calculus
2.5 The Group of Invertible Elements
2.6 Lomonosov's Invariant Subspace Theorem

Commutative Banach Algebras

2.7 Ideals and Homomorphisms
2.8 Gelfand Transforms
2.9 Involutions
2.10 Applications to Noncommutative Algebras
2.11 Positive functionals

Unit 3

Spectral Theory

3.1 Finite Dimensional Spectral Theory
3.2 Spectral Properties of Bounded Linear Operators
3.3 Spectral Theory of Compact Linear Operators
3.4 Spectral Properties of Bounded Self -Adjoint Linear Operators
3.5 Representation Theorem
3.6 Positive Operators
3.7 Projection Operators
3.8 Spectral Family

Unit 4

Some Problems of Non - Linear Functional Analysis

4.1 Differentiation of Abstract Functions of Real Variables
4.2 Integration of Abstract Functions Differential Equations
4.3 Homogeneous Forms and Polynomials
4.4 Differential of an Abstract Function

Unit 5

Applications

5.1 Approximation in Normed Linear Spaces
5.2 Uniform Approximation
5.3 Approximation in Hilbert Space

Topological Vector Spaces

5.4 Duality in Banach Spaces
5.5 The Normed Dual of a Normed Space
5.6 Adjoints
5.7 Compact Operators

BOOKS FOR STUDY AND REFERENCE

BalmohanV.Limaye, *Functional Analysis*, New Delhi: New Age International(P) limited, 1996, Third Edition 2014

Casper Goffman & George Pedric, *First Course in Functional Analysis***.** New Delhi: Prentice Hall of India Pvt., Ltd., 1974

Erwin Kreyszig, *Introductory Functional Analysis with Applications***.** New York: John Wiley & Sons, Inc., 1978

Hille, *Methods in Classical and Functional Analysis***,** Addison Wesley Publishing Company, 1972

Lusteraik, L.A., and V.J.Sobolev, *Elements of Functional Analysis*. New Delhi: Hindustan Publishing Corporation, 110 007

Walter Rudin, *Functional Analysis***.** New York: McGraw-Hill Book Company, 2006

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End Semester Examination: Total Marks: 100 Duration: 3 Hours

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M.Phil. DEGREE: BRANCH I - MATHEMATICS

SYLLABUS

PAPER – III OPTIONAL
FUZZY SET THEORY, FUZZY LOGIC AND APPLICATIONS

CODE: 19MT/RO/FT2 05 **CREDITS: 5**

OBJECTIVES OF THE COURSE

- To instill in depth knowledge of Fuzzy Mathematics
- To introduce advanced concepts in Fuzzy Mathematics leading to research

Unit 1

Fuzzy Sets

1.1 Operations on Fuzzy Sets
1.2 Fuzzy Complements, t-norms, t-co-norms
1.3 Fuzzy Arithmetic
1.4 Fuzzy Real Line

Unit 2

Fuzzy Relations

2.1 Binary Relations
2.2 Fuzzy Equivalence Relation
2.3 Fuzzy Ordering Relations
2.4 Fuzzy Morphisms
2.5 Compositions of Fuzzy Relations: sup-ω_i, inf-ω_i

Unit 3

Fuzzy Relational Equations

3.1 Partitioning – Solution Method
3.2 Fuzzy Relational Equations Based on sup-ω_i and inf-ω_i compositions

Unit 4

Fuzzy Logic

4.1 Fuzzy Propositions
4.2 Fuzzy Quantifiers
4.3Linguistic Hedges
4.4 Inference from Conditional Propositions
4.5 Fuzzy Expert System
4.6 Fuzzy Controllers

Unit 5

Applications of Fuzzy Mathematics and Fuzzy Logic

5.1 Pattern Recognition
5.2 Decision Making
5.3 Engineering

5.4 Industry
5.5 Medicine

BOOKS FOR STUDY AND REFERENCE

Ahmad M. Ibrahim, *Introduction to Applied Fuzzy Electronics*. New Delhi : Prentice Hall India, 1997.

Bart. Kosko, *Neural Networks and fuzzy systems*, New Delhi : Prentice-Hall of India, 2003.

George Klir J. and Folger Tina A., *Fuzzy Sets, Uncertainty and Information*. New Delhi : Prentice Hall India, 2004.

George Klir J. and Yuan Bo, *Fuzzy Sets & Fuzzy Logic Theory and Applications*, New Delhi : Prentice Hall India, 2009.

Toshiro Terano, Asai Kiyoji, Sugeno Michio, *Applied Fuzzy Systems*. New York : A.P. Professional, 1994.

Zadeh Lotfi A., *Fuzzy Sets and Their Applications to Cognitive and Decision Processes*, New York, Academic Press, 1975.

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M.Phil. DEGREE: BRANCH I - MATHEMATICS

SYLLABUS

(Effective from the academic year 2019-2020)

PAPER – III OPTIONAL

ADVANCED TOPICS IN GRAPH THEORY

CODE: 19MT/RO/AG2 05 **CREDITS: 5**

OBJECTIVES OF THE COURSE

- To instill in-depth knowledge in graph theory
- To introduce advance concepts in graph theory leading to research

Unit 1

Directed and Undirected Graphs

1.1 Undirected Graphs - Characterization
1.2 Digraphs – Directed Paths and Cycles
1.3 Tournament - Orientation

Unit 2

Ramsey Numbers

2.1 Independent Sets and Cliques
2.2 Ramsey's Theorem
2.3 Erdös Theorem
2.4 Turán's Theorem

Unit 3

Enumeration

3.1 Labeled Graphs
3.2 Enumeration of Graphs
3.3 Enumeration of Trees
3.4 Power Group Enumeration Theorem
3.5 Solved and Unsolved Graphical Enumeration Problem

Unit 4

Line, Interval and Chordal Graphs

4.1 Line Graphs – Properties – Characterization
4.2 Special Line Graphs
4.3 Line Graphs and Traversability
4.4 Interval Graphs
4.5 Intersection Graphs
4.6 Chordal Graphs - Characterization

Unit 5

Applications

5.1 Interconnection Networks
5.2 Applications of Graph Theory
5.3 Research Problems in Graph Theory- Domination,

Matching, Coloring, Labeling, Embedding, Minimum metric dimension, Packing, Algebraic Graphs

BOOKS FOR STUDY AND REFERENCE

Bondy J.A., Murty U.S.R., *Graph Theory with Application*. London: The Macmillan Press Ltd., 1982.

Chartrand Gary and Ping Zhang., *Chromatic Graph Theory*. London: CRC Press, 2009.

Geir Agnarson, Raymond Greenlaw, *Graph Theory: Modeling, Applications and Algorithms*. New Delhi: Pearson Education, 2012.

Harary Frank. *Graph Theory*. New Delhi: Narosa Publishing House, 2001.

Pratima Panigrahi, Rao S.B., *Graph Theory: Research Directions*. New Delhi: Narosa Publishing House, 2011.

West, D.B., *Introduction to Graph Theory* (second edition). New Delhi: Printice Hall of India Pvt., Ltd., 2003.

Xu Junming, *Topological Structure and Analysis of Interconnection Networks*. U.S.A.: Kluwer Academic Publishers, 2001.

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Theorem Writing Technique

End Semester Examination: Total Marks: 100 Duration: 3 Hours

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