DEPARTMENT OF MATHEMATICS

M.PHIL SYLLABUS

Effective from the Academic Year 2018 - 2019

H.H. The Rajah's College

Autonomous

Accredited at B+ by NAAC

Pudukkottai

Sl. No	Semester	Paper title	Exam Hrs	Marks		Credits
				Int	Ext	
1	I	Research Methodology	3 Hrs	40	60	4
2	I	**Area Paper**: Advanced Algebra & Analysis	3 Hrs	40	60	4
3	I	**Guide Papers: (Any One)** ➢ Fuzzy groups and Fuzzy graphs ➢ Topological vector spaces ➢ Lie Algebra	3 Hrs	40	60	4
4	I	Teaching and learning Studies	3 Hrs	40	60	4
5	II	Dissertation				8

Program Educational Objectives (PEOs)	
PEO1	Provide a strong foundation in diverse areas of mathematics so that students may compete with their peers and achieve in a variety of mathematics-related jobs.
PEO2	Motivate and prepare students to pursue higher education and research, thereby contributing to the country's growing academic demands.
PEO3	Enable students to operate effectively in multidisciplinary teams as leaders and team members by providing them with excellent communication and interpersonal skills, comprehensive knowledge, and an appreciation of multicultural and global viewpoints.
PEO4	Facilitate the holistic development of the student's personality, including the ability to deal with ethical and professional concerns, as well as the ability to learn independently and for the rest of his or her life.

Program Specific Outcomes (PSOs)	
After the successful completion of **M . P h i l . ,** **Mathematics** program, the students are expectedto	
PSO1	Communicate concepts of Mathematics and its applications.
PSO2	Learn to think analytically and logically using a variety of mathematical tools and strategies.
PSO3	Investigate real-world issues and discover how to address them using mathematical models.
PSO4	Acquire in-depth information and the skills to do research in order to pursue further education. Work as a mathematical expert.
PSO5	Attain goals of passing numerous exams/interviews for education, banking, industry, and other organizations/services.

Program Outcomes (POs)	
On successful completion of the M.Phil., Mathematics program, the students will be able to	
PO1	Demonstrate in-depth knowledge of Mathematics, both in theory and application.
PO2	Attain the ability to identify, formulate and solve challenging problems in Mathematics.
PO3	Know the various specialised areas of advanced mathematics and itsapplications.
PO4	Analyze complex problems in Mathematics and propose solutions using research-based knowledge.
PO5	Obtain the accurate solutions for the community oriented problems via various mathematical models.
PO6	Apply the Mathematical concepts, in all the fields of learning including higher research, and recognize the need and prepare for lifelong learning.
PO7	Crack lectureship and fellowship exams affirmed by UGC like CSIR-NET and SET.

Core Course : RESEARCH METHODOLOGY

UNIT – I:

LOGIC: Propositions and Logical Operations – Conditional Statements – Methods of Proof – Mathematical Induction.

UNIT –II:

MATLAB : Programming in Matlab – Polynomials, Curve Fitting and Interpolation -Applications in Numerical Analysis.

UNIT –III:

TOPOLOGY : Homotopy of paths – The Fundamental Group – Covering Spaces - The Fundamental Group of the Circle – Retractions and Fixed Points.

UNIT –IV:

TOPOLOGY : Deformation Retracts and Homotopy Type – The fundamental Group of Sn - Fundamental Groups of Some Surfaces.

UNIT – V:

DIFFERENTIAL EQUATIONS: Uncoupled Linear systems – Diagonalization – Exponentials of operators – Fundamental theorem for Linear systems – Linear Systems in R2 – Complex eigen values – Multiple eigen values – Jordan forms – Stability theory – Non-homogeneous linear systems.

TEXT BOOK(S):

1. B. Kolman, R.C. Busby and S.C. Ross, Discrete Mathematical Structures, Fourth Indian reprint, Pearson Education Pvt Ltd, New Delhi, 2003. Unit I – Chapter 2

2. Amos Gilat, MATLAB An Introduction with Applications, John wiley & sons, 2004. Unit II – Chapters 7, 8 and 10

3. James R. Munkres, Topology (2nd Edition), Prentice Hall of India, Pvt. Ltd., New Delhi, 2004. Unit III - Chapter 9 : Sections 51 -55. Unit IV - Chapter 9: Sections 58-60.

4. L. Perko, Differential Equations and Dynamical systems, Springer-Verlag, First Indian Reprint, 2004. Unit V – Chapter 1 – 1.1 to 1.10

REFERENCES

[1] J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill, New Delhi, 1997.
[2] I.M. Singer and J.A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer Verlag, 2004.
[3] E.A Coddington and N. Levinson, Theory of Ordinary differential equations , Tata McGraw Hill, New Delhi, 1972.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
https://youtu.be/YBPnNRU2ocI
https://youtu.be/IuEOMyGuuIg
https://youtu.be/UBlYS45a5yE
https://youtu.be/u5F9K8eld4c

Course Outcomes:	
On the successful completion of the course, student will be able to:	
CO1	Demonstrate the ability to choose methods of Propositions and Logical Operations
CO2	Understand the Programming in Matlab and Applications in Numerical Analysis.
CO3	understand a general definitions of Homotopy of paths and The Fundamental Group of the Circle.
CO4	Develop advanced critical thinking skills in Fundamental Groups of Some Surfaces.
CO5	Analyze the concept of Differential equations, Uncoupled Linear systems, Multiple eigen values, Jordan forms, Stability theory and Non-homogeneous linear systems.

Course Outcome Vs Programme Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**6**	**3**	**3**	**3**	**6**	**9**	**3**
CO2	**9**	**9**	**6**	**3**	**3**	**9**	**3**
CO3	**6**	**3**	**9**	**6**	**9**	**6**	**6**
CO4	**6**	**3**	**9**	**9**	**9**	**6**	**6**
CO5	**3**	**6**	**6**	**9**	**6**	**3**	**9**

Level of correlation: 9 – High; 6 – Medium; 3 – Low; and 0- no correlation.

M. Phil Mathematics
Core course: ADVANCED ALGEBRA

UNIT I

Definition of Category – examples – isomorphism, automorphism and endomorphism in a category – operation of a group on an object of a category – Universal objects in a category – Products and Coproducts – Covariant and contra variant functors – examples of functors – representation functors and examples – isomorphism of functors – representable functors.

UNIT II

Polynomials and group rings – Localization

UNIT III

Basic definitions relating to modules– Group of homomorphisms – Direct products and sums of modules – Free modules – Vector spaces – The dual space.

UNIT IV

Abstract Integration: The concept of measurability – simple functions – Elementary properties of measures – Integration – Convergence theorems –Role played by set of measure zero

Chapter I

UNIT V

Reisz Representation theorem: Topological preliminaries - Riesz representation theorem – Regularity properties of Borel measures –Lebegue measure – continuity properties of measurable functions

TEXT BOOKS

1. Serge Lang, "Algebra", Springer - Verlag, Revised Third Edition, 2002.

Unit – I - Chapter I Section 11 excluding the following

(i) example on Page 60 relating to tensor product of commutative rings

(ii) example on Page 63 relating to compact manifolds

(iii) the last example on Page 65 relating to the category of projective non-singularvarieties over the complex numbers.

Unit – II - Chapter II sections 3 and 4.

Unit- III - Chapter III: Sections 1 to 6 excluding the following

(i) example on Page 121 relating to the ring of differential operators with Ccoefficients and the theory of Lie groups

(ii) example on Page 134 relating to the category of complexes of modules over aring, vector bundles over a topological space and sheaves of abelian groupsover a topological space.

Unit – IV - Chapter – VII : Sections 1 and 2

Unit – V - Chapter – X : Sections 1 to 4.

2. W. Rudin, Real and Complex Analysis, 3rd edition, McGraw Hill International, 1986

REFERENCE(S)

1. Serge Lang, Complex Analysis, Addison Wesley, 1977.
2. V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005.
3. P. Halmos, Measure theory, Springer.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
https://youtu.be/5kSwTofWT6M
https://nptel.ac.in/content/storage2/111/106/111106113/MP4/mod08lec44.mp4
https://nptel.ac.in/content/storage2/111/106/111106113/MP4/mod08lec45.mp4
https://nptel.ac.in/content/storage2/111/106/111106131/MP4/mod08lec39.mp4
https://nptel.ac.in/content/storage2/111/106/111106131/MP4/mod08lec42.mp4

Course Outcomes	
On the successful completion of the course, student will be able to:	
CO1	Define and Explain Category isomorphism, automorphism and endomorphism in a category, Products and Coproducts.
CO2	Understand the Polynomials and group rings and Localization.
CO3	Understand the Basic definitions relating to modules, Vector spaces and the dual space.
CO4	Facility in working with abstract integration and Convergence theorems,Role played by set of measure zero.
CO5	Analyze the concept of Reisz Representation theorem.

Course Outcome Vs Programme Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**6**	**3**	**3**	**3**	**6**	**9**	**3**
CO2	**9**	**9**	**6**	**3**	**3**	**9**	**3**
CO3	**6**	**3**	**9**	**6**	**9**	**6**	**6**
CO4	**6**	**3**	**9**	**9**	**9**	**6**	**6**
CO5	**3**	**6**	**6**	**9**	**6**	**3**	**9**

Level of correlation: 9 – High; 6 – Medium; 3 – Low; and 0- no correlation.

M. Phil Mathematics

SOFT CORE :Fuzzy Groups and Fuzzy Graphs

Unit – I

Basic concepts - notations – subsets – algebra of sets –power sets – relations on sets – definition and examples – cardinality of a set – some operations on set – venn diagram - ordered pairs and n-tuples – cartesian products - examples-relations–types of relations with examples - some operations on relations – composition of relations - functions – types of functions with examples – composition of functions – inverse function – characteristic function of a set – Basic concepts of graph theory, paths , reachabilityand connectedness , matric representation of graphs - Trees.

Text Book 1 Chapter 2 Section: 2.1,2.3,2.4 and Chapter 5 Section 5.1

Unit II

Fuzzy Sets – fuzzy subgroups – normal fuzzy subgroups – homomorphism and isomorphism – level subgroups – cosets – equivalence classes – fuzzy subgroups based on group properties.

Text Book 2 Chapter 1 Section: 1.1 to 1.4 and Chapter 10 Section: 10.2 and 10.4

Unit III

Properties of normal fuzzy subgroups - Characteristic Fuzzy Subgroups and Abelian Fuzzy Subgroups - Fuzzy Caley's Theorem and Fuzzy Lagrange's Theorem.

Text Book 2 Chapter 2Section: 2.1 – 2.3

Unit IV

Introduction to fuzzy graphs – fuzzy cut sets, fuzzy chords, fuzzy cotree and fuzzy twigs, fuzzy cocycles – fuzzy cycle set and fuzzy cocycle set - fuzzy line graphs , Fuzzy intersection graphs, Fuzzy interval graphs – The Fulkerson and gross Characterization – The Gilmore and Hoffman Characterization.

Text Book 3 Chapter 2 Section: 2.1 – 2.2

Unit V

Operations on Fuzzy Graphs- Cartesian Product and Composition , Union and Join , On fuzzy Tree definition

Text Book 3 Chapter 2 Section: 2.4 – 2.5

Text Book:

1.J.P. Tremblay , R.Manohar, Discrete Mathematical Structures with Applications to Computer Science,Tata McGraw- Hill Edition 1997.

2.John N. Mordeson,Kiran R. Bhutani, Azriel Rosenfeld , Fuzzy Group Theory, 2005 , Studies in Fuzziness and Soft Computing, Volume 182 ,ISBN 3-540-25072-7.

3.J. N. Mordeson and P.S. Nair, Fuzzy Graphs and Fuzzy Hypergraphs, Physica- Verlag, 2000.

References:

1. VasanthaKandasamy W. B., "Smarandache Fuzzy Algebra ",American Research press, Rehoboth, 2003.

2.SurajitBorkotokey, " Advanced Topics in fuzzy algebra", Vdmverlag , paperback ,June-2010.

3. D.S. Malik and J.N. Mordeson, Fuzzy Discrete Structures, Physica - Verlag , 2000.

M. Phil. Mathematics
SOFT CORE : TOPOLOGICAL VECTOR SPACES

Unit I:
Topological vector spaces : Introduction – separation properties – Linear mappings – Finite dimensional spaces – metrization –boundedness and continuity – seminorms and local convexity – quotients spaces – examples.

Unit II:
Completeness: Baire category – The Banach–Steinhaus theorem – The open mapping theorem – The closed graph theorem – Bilinear mappings.

Unit III:
Convexity: The Hahn Banach theorems – Weak topologies – compact convex sets – vector valued integration.

Unit IV:
Duality in Banach spaces: The normed dual of a normed space – Adjoint – compact operators.

Unit V:
A continuity theorem – closed subspace of L^p- spaces – The range of a vector valued measure – A generalized Stone-Weierstrass theorem – two interpolation theorems – Kakutani's fixed point theorem – Haar measure on compact group – uncomplemented subspaces.

Text book:
Walter Rudin, Functional Analysis, 2nd edition, Tata McGraw-Hill, New Delhi, 2006.

Reference:
John. B. Conway, A course in Functional analysis, 2nd edition, GTM, Springer, New Delhi, 2006.

M. Phil. Mathematics

SOFT CORE : LIE ALGEBRA

Unit I :
Basic Concepts of Lie Algebras: Definitions and examples.

Unit II :
Ideals and homomorphisms

Unit III :
Solvable and nilpotent Lie algebras

Unit IV :
Semisimple Lie algebras : Theorems of Lie and Cartan, Killing form

Unit V :
Complete reducibility of representations and representation of sl(2,F).

Text book:
James E. Humphreys, Introduction to Lie Algebra and Representation theory, Springer, New Delhi, 2010.

M. Phil. Mathematics

TEACHING AND LEARNING STUDIES

Unit I: Computer applications skills

Computer system: Characteristics, Parts and their functions – Different generations of computer – operation of computer: switching on/off/restart, Mouse control, use keyboard and some functions of key – information and communication technology (ICT): definition, meaning, features, trends – Integration of ICT in teaching and learning – ICT applications: Using word processor, spread sheets, power point slides in classroom – ICT for research: Online journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations.

Unit II: Communication Skills

Communication: Definitions - Elements of communication: Sender, message, channel, receiver, Feedback and noise – Types of communication: Spoken and written; Non-verbal communication – Barriers to communication: Mechanical, Physical, Linguistic &cultural – Skills of co0mmunication: Listening, speaking, reading and writing - Methods of developing fluency in oral and written communication – Style, Diction and vocabulary – classroom communication and dynamics.

Unit III: Communication Technology

Communication Technology: Bases. Trends and Developments – Skills of using communication Technology – computer mediated teaching: Multimedia, E-content - Satellite-based communication: EDUSAT and ETV Channels. Communication through web: Audio and video applications on the internet, interpersonal communication through the web.

Unit IV: Pedagogy

Instructional Technology: Definition, Objectives and types – Difference between teaching and instruction – Lecture Technique: Steps, Planning of a lecture, Delivery of a lecture – narration in tune with the nature of different disciplines – Lecture with power point presentation – Versatility of lecture technique – Demonstration: Characteristic, principles, Planning Implementation and evaluation – Teaching – learning Techniques: Team teaching, Group discussion, Seminar, workshop, Symposium and panel discussion – modes of teaching: CAI, CMI and WBI.

Unit V: Teaching Skills

Teaching skill: Definition, Meaning and nature – Type of teaching a skills: Skill of set induction, skill of stimulus variation, skill of explaining, skill of probing questions, skill of black board writing and skill of closure – Integration of Teaching skills – Evaluation of teaching skills.

References

1. Bela Rani Sharma, Curriculum reforms and teaching methods, Sarup and sons, New Delhi, 2007.
2. Don Skinner, Teacher training, Edinburgh Universitypress ltd., Edinburgh, 2005.

3. Information and communication technology in Education: A curriculum for schools programme of teacher development, Jonathan Anderson and Tom Van Weart, UNESCO, 2002.
4. Kumar, K.L, Educational Technology, New age international publishers, New Delhi 2008.
5. Mangal, S.K, Essential of teaching – Learning and information Technology, Tendon Publication, Ludhiana, 2002.
6. Michael, D and William, Integrating Technology into teaching and learning: concepts and applications, Prentice Hall, New York, 2000.
7. Pandey, S.K, Teaching communication, common wealth publisher, New Delhi, 2005.
8. Ram Babu, A and Dandapani, S, Microteaching (Vol. 1 & 2), Neelkammal Publications, Hyderabad, 2006.
9. Singh V. K and Sudarshan K.N, computer education, Discovery Publishing Company, New York, 1996.
10. Sharma, R.A, Fundamental of educational technology, Surya Publications, Meerut, 2006.
11. Vanaaja, M, and Rajasekar, S, Computer Education, Neelkammal Publications, Hyderabad, 2006.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
https://youtu.be/pd6wZuP2DAk
https://youtu.be/GGiUbpgtB9k
https://youtu.be/lo1_1XqlfEg

Course Outcomes	
On the successful completion of the course, student will be able to:	
CO1	Describe the concepts of Computer applications skills.
CO2	Understand the Communication Skills.
CO3	Applying the Communication Technology.
CO4	Analyze the Instructional Technology and Demonstration, Teaching, learning Techniques.
CO5	Analyze the concept of Teaching Skills.

Course Outcome Vs Programme Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	**6**	**3**	**3**	**3**	**6**	**9**	**3**
CO2	**9**	**9**	**6**	**6**	**3**	**9**	**3**
CO3	**9**	**6**	**9**	**6**	**3**	**6**	**6**
CO4	**6**	**3**	**9**	**9**	**9**	**3**	**9**
CO5	**3**	**6**	**6**	**9**	**6**	**3**	**9**

Level of correlation: 9 – High; 6 – Medium; 3 – Low; and 0- no correlation