L. N. GOVT. COLLEGE (AUTONOMOUS)
PONNERI-601204

Post Graduate

Department of Mathematics

M. Phil. Mathematics Syllabus

(**For candidates admitted from 2020 -21 onwards**)

M. Phil. MATHEMATICS

CHOICE BASED CREDIT SYSTEM

1.   PROGRAMME OF STUDY:

1.1   Framing Course for M.Phil.

The M.Phil candidates shall write three Courses:
(I) Research Methodology and Advanced Analysis.
(II) Algebra and Topology.
(III) Topic of Research. (Guide Paper) to equip the candidate with skills in the Research area.

For each Course. 20% of marks would be allotted for the continuous internal Assessment (CIA) and the remaining 80% would be allotted for the final Examination.

The following components shall be adopted for Continuous Internal Evaluation / Assessment:

1.	Best 2 tests out of 3	10 Marks
2.	Attendance	05 Marks
3.	Seminar	05 Marks
	Total	**20 Marks**

Question Paper Pattern for M.Phil. Programme:

Section A: **4 x 5 = 20 Marks**

 (Four Questions out of Six Questions and at least one
    questions from each unit)

Section B: **4 x 15 = 60 Marks**

 (Four Questions out of Six Questions and at least one
    Questions from each unit)

_____
80 Marks

_____

The syllabi for Courses I and II shall be prescribed by the Board of Studies. The syllabus for Course III shall be formulated by the subject expert / guide. The Syllabi for all the 3 courses shall consist of five units. For the Full-Time candidate Courses – I, II, and III will be covered in the first semester and dissertation will be covered in the Second Semester. For the Part-Time candidate Courses – I, II and III will be covered in the first year and dissertation in the Second year.

1.2 Dissertation

Candidates shall submit three copies of dissertation (two copies to the University and one copy to the guide) and the minimum and maximum page limited from 75 to 150 respectively and the dissertation be printed on both sides of a paper and hard bound of the same need not be necessary, after **the successful completion of the all Course works** to the University through the Supervisor and the Head of the Department / Principal not earlier than 5 months from the date of start of the second semester in the case of Full-Time Programme and not earlier than 10 months from the date of start of the second year, in the case of Part-Time Programme. If a candidate is not able to submit his / her dissertation within the period stated above, he / she shall be given an extension time.

1.3 The dissertation shall be valued by one external examiner who is within the University jurisdiction and by the Research Supervisor for Maximum of 150 marks by each examiner and the average of the marks awarded by both the examiners shall be taken for consideration. The external examiner shall be selected from a panel of 3 experts suggested by the Research Supervisor and working within the University area of the Research Supervisor. However, the University may ask for another panel, if necessary.

1.4 An open Viva-Voce examination shall be conducted by both the external examiner and the supervisor **and shall be attended by members of Department Research Committee members, all faculty members of the departments, other research scholars and other interested experts / researchers** and evaluated jointly by the examiner and the Supervisor for the maximum of 50 marks. The valuation of M.Phil. Dissertations and the viva-voce examination shall be carried out on the same day at the place of the Research Supervisor (viva is to be conducted only if the student passes in the valuation of the dissertation). The mark should be sent to the Controller of Examinations by the Research supervisor. A candidate shall be declared to have passed Part-II Examination if he secures not less than **55%** of the marks prescribed for the dissertation and **55%** of the marks prescribed for the viva-voce Examination.

1.5 The dissertation shall ordinarily be written in English. However, the option of writing the dissertation in Tamil is given to the candidates at the time of assigning the candidates to the Supervisor, in mutual consultation with the Research Supervisor and the Scholar.

1.5.1 If the examiner who values the dissertation makes a qualified recommendation such as revision of dissertation, the candidate shall be advised to revise the dissertation in the light of the suggestions made by the examiners and re-submit the dissertation, within a period of SIX months. A fee shall be charged as fee for Re-submission of dissertation. The revised dissertation shall be sent to the same examiner who evaluated the dissertation in the first instance.

Course: M.Phil. Mathematics

No.	Semester	Subject Code	Subject Name	Nature	Inst. Hours	Credit	Exam Hours	Max Marks Int	Max Marks Ext	Total	Passing Minimum	% calculation
1	I		Research Methodology and Advanced Analysis	Paper I	6	5	3	20	80	100	0	Yes
2			Algebra and Topology	Paper II	6	5	3	20	80	100	50	Yes
3			**Optional Subject I:** Complex Analysis	Optional Paper III	6	5	3	20	80	100	50	Yes
4			**Optional Subject II:** Advanced Graph Theory	Optional Paper III	6	5	3	20	80	100	50	Yes
5			**Optional Subject III:** Stochastic Processes	Optional Paper III	6	5	3	20	80	100	50	Yes
6			**Optional Subject IV:** Modern Graph Theory	Optional Paper III	6	5	3	20	80	100	50	Yes
	II		**Dissertation**					21 credits				
			Total					**36 Credits**				

CORE PAPER I

Semester	Subject Code	Subject Title	Total Hours	Credit
I		**RESEARCH METHODOLOGY AND ADVANCED ANALYSIS**	**90**	**5**

Objective	• To learn to construct, analyze and solve the research problem. • To design a research problem. • To introduce Holomorphic Fourier Transforms. • To study H^p and N spaces.
Learning Outcomes	**After completion of this course, students will be able:** • To understand about the Research. • To do some research based on the optional paper. • To apply Fourier transforms in various fields like Digital signal processing, Signals and systems, Music, etc.

Unit 1	**Research Methodology:** An introduction – Defining the Research Problem – Research Design.
Unit 2	**Holomorphic Fourier Transforms:** Introduction – Two theorems of Paley and Wiewer – Quasi-Analytic classes – The Deujoy – Carleman theorem.
Unit 3	**Conformal mapping:** Preservation of angles, Linear Fractional transformations, Normal families, The Riemann mapping theorem, The class ζ continuity at the boundary, Conformal mapping of an annulus.
Unit 4	**H^p Spaces:** Subharmonic functions – The spaces H^p and N – The theorem of F and M. Riesz Factorization theorems – The Shift operator – Conjugate functions.
Unit 5	**Fourier Transforms:** Formal properties, The inversion theorem, The Plancheral Theorem, The Banach Algebra L^1 .

Contents & Treatment as in	**Research Methodology by C.R. Kothari, Vishwa Prakashan, 1990.** Unit 1: Chapter 1, 2 and 3. **Real and Complex Analysis by Walter Rudin, 3rd Edition, Mc Graw Hill Publications.** Unit 2: Chapter 19 Unit 3: Chapter 14 Unit 4: Chapter 17 Unit 5: Chapter 9
Books for Reference	1. Research methodology, Ranjit Kumar, SAGE Publications Limited, India 2. Research Design, John W. Creswell and J. David Creswell, SAGE Publications Limited, India 3. Fourier Analysis on Groups, Walter Rudin, Mc Graw Hill Publications.

.

CORE PAPER II

Semester	Subject Code	Subject Title	Total Hours	Credit
I		**ALGEBRA AND TOPOLOGY**	**90**	**5**

Objective	- To introduce the concept of Modules, Rings and Modules of fractions. - To learn about Primary Decomposition, Chain conditions, Notherian rings and Artin rings. - To study about Fundamental Groups and Covering spaces.
Learning Outcomes	**After Completion of this course, students will be able:** - To understand the Classical Algebra - To apply the concept in Computer Vision, Robotics, Computer Graphics, etc. - To use Fundamental group and covering spaces in areas like Riemann Geometry.
Unit 1	Modules
Unit 2	Rings and Modules of fractions (Algebras not included)
Unit 3	Primary Decomposition: Chain conditions
Unit 4	Notherian rings, Artin rings
Unit 5	The Fundamental Group – Covering Spaces
Contents & Treatment as in	**Introduction to Commutative Algebra by M.F. Atiyah, I. G. Mac Donald Addison – Wesley, 1964.** Unit 1: Chapter 1 Unit 2: Chapter 2 and Chapter 3. Unit 3: Chapter 4 and Chapter 4. Unit 4: Chapter 7 (Omit Sections – 7.7 to 7.10) and Chapter 8. **Lecture Notes on Elementary Topology and Geometry, I.M. Singer and J.A. Thorpe, Springer – Verlag, 1967.**

	Unit 5: Chapter 2 and Chapter 3.
Books for Reference	1. **Commutative Algebra, N.S. Gopalakrishnan, Orient Blackswan Private Limited, New Delhi.** 2. **Algebra, M. Artin, Pearson Education India.** 3. **Topology and Geometry, Glen E. Berdon, Stanford Mathematics, Springer.**

OPTIONAL COURSE I

Semester	Subject Code	Subject Title	Total Hours	Credit
I		**COMPLEX ANALYSIS**	90	5

Objective	- To understand the class of Analytic, Univalent functions. - To learn about the Geometrical properties of Analytic functions. - To introduce Harmonic Univalent mappings.
Learning Outcomes	**After completion of this course:** - The student will be able to understand the Geometrical behavior of the Analytic functions. - The students will apply and solve the differential equations in Lowner theory. - Can use the concept in Filter theory.
Unit 1	Introduction – The Area theorem – Growth and Distortion theorem – Coefficient Estimates – Convex and Star-like Functions – Close-to-convex functions – Spiral-like functions.
Unit 2	Typically real functions – A Primitive Variational Method – Growth of Integral Means – Odd Univalent functions – Asymptotic Bieberbach Conjecture.
Unit 3	Sub-ordination – Basic Principles – Coefficient Inequalities – Sharpened Forms of the Schwarz Lemma – Majorization – Univalent Subordinate functions.
Unit 4	Normalizations – Normal families – The Harmonic Koebe Function – Coefficient Conjectures.
Unit 5	Extremal problem – Minimum Area – Covering theorems – Examination of a_2- Growth and Distortion – Marty Relation – Typically Real functions – Star-like functions.
Books for Reference	1. Univalent functions, P.L Duren, Springer-Verlag, New York. 2. Harmonic Mappings in the Plane, P.L Duren, University Press. 3. Univalent functions Vol. I and Vol. II, A. W. Goodman, Mariner Publishing Co.

OPTIONAL COURSE II

Semester	Subject Code	Subject Title	Total Hours	Credit
I		**ADVANCED GRAPH THEORY**	90	5
Objective	**The main objective of this course is** • To introduce graphs, interconnection networks, planar graphs and layout of VLSI circuits • To learn vertex transitive graphs, edge transitive graphs, atoms of graphs and Cayley graphs. • To draw hypercube networks, De Bruijn Networks, Mesh Networks, Grid Networks, Butterfly Networks and Benes Networks • To learn Fault Tolerant and routings in networks.			
Learning Outcomes	**Students will acquire** • Basic ideas on graphs and interconnection networks • Knowledge of Vertex Transitive Graphs, Edge Transitive Graphs, Atoms of Graphs, Connectivity of Transitive Graphs and Cayley Graphs • Skill of drawing hypercube networks, De Bruijn Networks, Mesh Networks, Grid Networks, Butterfly Networks and Benes Networks • Knowledge of Fault Tolerant and routings in networks.			
Unit 1	Interconnection Networks and Graphs: Graphs – Interconnection Networks – Trees - Embeddings and Planar Graphs – Trees and *k*-ary trees – Embedding of Graphs – Planar Graphs and Layout of VLSI Circuits.			
Unit 2	Cayley Method: Vertex Transitive Graphs – Edge Transitive Graphs – Atoms of Graphs – Connectivity of Transitive Graphs – Cayley Graphs.			
Unit 3	Well known Topological Structures of Interconnection Networks: Hypercube Networks – Two Equivalent Definitions – Some Basic properties – Gray Codes and Cycles – De Bruijn Networks – Three Equivalent Definitions – Eulerian and Hamiltonian Properties – Uniqueness of Shortest Paths – De Bruijn Undirected Graphs			
Unit 4	Other Topological Structures of Networks: Mesh Networks and Grid Networks – Pyramid Networks – Cube- connected cycles – Butterfly Networks – Benes Networks.			
Unit 5	Fault Tolerant Analysis of Interconnection Networks: Routings in Interconnection Networks – Forwarding Index of Routing – Edge Forwarding Index of Routing - Delay of Fault -Tolerant Routing.			

**Contents &
Treatment
as in**
	**Topological Structure and Analysis of Inter connection Networks by
	Junmimg Xu, Kluwer Academic Publishers, London.**
	
	  Unit I: 1: 1.1 – 1.1.2
	
	            1.3 – 1.3.1 – 1.3.3
	
	  Unit II: 2: 2.2 – 2.2.1 – 2.2.5
	
	  Unit III: 3: 3.2 – 3.2.1 – 3.2.4
	
	  Unit IV: 3: 3.5 – 3.5.1 – 3.5.5
	
	  Unit V: 4: 4.1 – 4.1.1 – 4.1.3

**Books for
Reference**
	1. Advanced Graph Theroy and Combinatorics by Michel. Rigo, Wiley ISTE.
	2. Graphs, Networks and Algorithms (4th Edition), Dieter Jungnickel, Springer
	     Verlag, Berlin Heidelberg.
	3. First look at Graph Theory, J. Clark and D. A. Holton, Allied Publishers, New
	       Delhi, 1995.
	4. Graph Theory, R. Gould, Benjamin/Cummings, Menlo Park, 1989.
	
	5.Graphs, An Introductory Approach, R. J. Wilson and J. J. Watkins, John Wiley
	   and Sons, New York, 1989.

OPTIONAL COURSE III

Semester	Subject Code	Subject Title	Total Hours	Credit
I		**STOCHASTIC PROCESSES**	**90**	**5**

Objective	- The theory of Stochastic Modelling is considered to be an important contribution to Mathematics and it is an active topic of research - This course will consider Markov Processes in discrete and continuous time. - To familiarize the students with the application of probabilistic and stochastic methods in queuing theory.
Learning Outcomes	**At the end of the course, the students would be able:** - To understand the classification of Markov chains. - To apply Renewal theory in Filtered Renewal Process in Hydrology. - To apply Queuing theory in traffic signals, banks, ticket counters, etc.
Unit 1	Classification of Markov chains – Higher transition probabilities in Markov Classification of state and chains – Stability of a Markov system – Limiting behavior: Irreducible Ergodic chain.
Unit 2	Markov processes with discrete state space – Poisson process and its properties – Simple Birth and Death process – Martingales – Martingales Convergence theorem.
Unit 3	Renewal Processes – Renewal Processes in continuous time – Wald's equation – Elementary Renewal theorem – Delayed and Equilibrium Renewal processes.
Unit 4	Non-Markovian Queuing system – Embedded Markov chain technique for M/G/1 models – Busy period – M/G/1/N, $M^{[x]}$/G/1, M/G(a, b)/1 Model, G/M/1 Model – Transient state- Distribution of M/G/1 model – Markov renewal process and semi Markov process.
Unit 5	Vacation models and Retrial Queue: Queuing systems with Vacation – Stochastic decomposition – M/G/I system with vacation - Retrial Queuing system – Model description – M/M/1, M/G/1 Retrial Queue – Heavy tailed distribution .
Books for Reference	1. Stochastic Processes, J. L. Doob, John Wiley and Sons Inc., New York. 2. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis, S. Unnikrishna Pillai, McGraw Hill, Europe, IV Edition, 2002. 3. Fundamental of Queuing theory, D. Gross and C.M. Hassis, John Wiley and Sons. 4. The Theory of Stochastic Processes, D. R. Cox, H. D. Miller, Chapman and Hall/CRC,1977. 5. Stochastic Processes, Sheldon M. Ross Author, Wiley, II Edition,1995. 6. Stochastic models in Queuing theory, J. Methi, Academic press.

<div align="center">

OPTIONAL COURSE IV

</div>

Semester	Subject Code	Subject Title	Total Hours	Credit
I		**MODERN GRAPH THEORY**	**90**	**5**
Objective	**The main objective of this course is:** • To introduce the Structure and Symmetry of Graphs • To learn about Trees and Connectivity • To know more about Graph colorings • To study about the Dominations in Graphs briefly			
Learning Outcomes	**After completion of this course, the students will able:** • To develop their knowledge in the application of Graph theory in various fields like Tele communications, Chemical bonding structure, etc. • To use coloring of graphs in the field like Mobile radio frequency, Face recognition pattern, etc.			
Unit 1	**Structure and symmetry of Graphs:** Cut-vertices-bridges-blocks-Automorphism, group-Cayley color graphs-The Reconstruction Problem.			
Unit 2	**Trees and Connectivity:** Tree- Properties of trees- Arboricity and vertex Arboricity -Connectivity- Edge Connectivity- Menger's theorem-Vulnerability of graphs.			
Unit 3	**Graph Colorings:** Vertex Colorings-Edge Colorings-Map Colorings and flows .			
Unit 4	**Matchings, Factors and Decompositions:** Matchings and independence in Graphs-Factorizations and decompositions – Labelings of graphs.			
Unit 5	**Dominations in Graphs:** The Domination number of a graph-The Independent domination number of a graph – Other Domination parameters.			
Contents & Treatment as in	**Graphs and Digraphs, G. Chartrand and L. Lesniak, Chapman and Hall, 2000.**			
Books for Reference	1. Graph Theory and its Applications, J.A. Bondy and U.S.R Murty, North Holland, 2. Graph Theory, Frank Harary, Narosa Publishing House.			