



**M.Phil. MATHEMATICS (FT/PT) PROGRAMME**

(For the candidates to be admitted from the academic year 2018-19 onwards)

**ELIGIBILITY :** M.Sc. Mathematics

**PROGRAMME OBJECTIVES :**

- To prepare students for successful career in research institutes and various fields.
- To develop the ability among the students to apply mathematical techniques in research.
- To enable the students to work as a team with multidisciplinary approach.
- To provide students with fundamental strength in analyzing, designing and solving research oriented problems.
- To promote and inculcate ethics and code of professional practice among students.

**PROGRAMME STRUCTURE**

Sem-ester	Course	Title of the Course	Exam. Hours	Credits	Marks		
					IA	UE	Total
I	Course - I	Research Methodology	3	4	25	75	100
	Course - II	Algebra and Analysis	3	4	25	75	100
	Course – III	Teaching and Learning skills (Common Paper)	3	4	25	75	100
	Course - IV	Paper on Topic of Research (The syllabus will be prepared by the Guide and the examination will be conducted by the COE)	3	4	25	75	100
II	---	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks	--	8	--	--	200
<b>Total</b>				<b>24</b>	--	--	<b>600</b>

**PROGRAMME OUTCOMES :**

- After successful completion of Master of Philosophy in Mathematics students will be able to demonstrate basic knowledge in mathematical science.
- The students would acquire basic knowledge of research and skills to design and conduct classes and interpret the results.
- The students will be able to demonstrate understanding of basic knowledge in modern mathematical techniques.
- The students will be able to acquire knowledge to solve real life problems.
- The students will be able to reinforce research skills and high end recent advances in mathematics.
- The students will be able to communicate effectively and demonstrate professional and ethical responsibilities.

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## **COURSE I**

### **RESEARCH METHODOLOGY**

#### **Course Objectives :**

- To understand and apply the fundamental concepts of graphs in dominating sets.
- Discuss the concepts of dominating numbers, bounds.
- To apply graph theory based tools in solving practical problems.
- Be familiar with basic concepts of topology.
- Gain mathematical maturity.
- Become competent in writing.
- Apply special imagination to theory.
- To give an in-depth knowledge of solving linear systems.
- To explain the concepts of complex eigen values and multiple eigen values.
- Analyze the structure of real world problems and plan solution strategies to solve the problems using appropriate tools.

#### **UNIT I : GRAPH THEORY**

Dominating sets in Graphs – Sets of Representatives – Applications of Domination Numbers

#### **UNIT II : GRAPH THEORY**

Bounds on the Domination Number – Bounds in terms of Order, Degree, Packing, Size, Diameter, Girth, Independence and Covering

#### **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  $S^n$  - Fundamental Groups of Some Surfaces.

#### **UNIT V : DIFFERENTIAL EQUATIONS**

Uncoupled Linear systems – Diagonalization – Exponentials of operators – Fundamental theorem for Linear systems – Linear Systems in  $R^2$  – Complex eigen values – Multiple Eigen values

#### **TEXT BOOK (S) :**

1. Teresa W. Haynes, Stephan T.Hedetniemi, Peter J. Slater, Fundamentals of Domination in Graphs, 1998 – CRC Press  
Unit I – Chapter 1 : Sections 1.1 to 1.13  
Unit II – Chapter 2 : Sections 2.1 to 2.5

2. 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.
3. L. Perko, Differential Equations and Dynamical systems, Springer-Verlag, First Indian Reprint, 2004.  
Unit V - Chapter 1 - 1.1 to 1.7

## **REFERENCES**

1. R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory, Springer, 2012
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.

## **Course Outcomes :**

- To get a strong background of graph theory concepts.
- To apply principles and concepts of graph theory in practical situation.
- Write precise and accurate mathematical definitions of objects in graph theory.
- To know the definitions of standard terms in topology.
- To know a variety of examples and counter example.
- To improve the proof writing skills.
- To get a strong knowledge of solving a linear system.
- Improve and outline the logical thinking.
- Shown the ability of working independently.

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## **COURSE II**

### **ALGEBRA AND ANALYSIS**

#### **Course Objectives :**

- To know the definitions and understand the key concepts introduced in this modules.
- To be able to investigate the properties of modules.
- The concept of a module as a generalization of a vector space and an abelian group.
- Have the knowledge of basic properties of primary decompositions and Noetherian Rings.
- Studying Nakayama's lemma
- Studying the topological concepts and Riesz representation theorem.
- Studying the notion of Lebesgue measure and their properties.
- To learn the concepts of Laplace transforms and inverse Laplace transforms.
- To know the concepts of Inversion theorem and Plancherel theorem.
- To learn the ideas of transformations.
- To study the Riemann mapping theorem.
- Solve difficult problems using the above concepts.

#### **UNIT I : MODULES**

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

#### **UNIT II : NOETHERIAN RINGS**

Basic criteria – Associated primes – Primary decomposition - Nakayama's lemma

#### **UNIT III : REISZ REPRESENTATION THEOREM**

Topological preliminaries - Riesz representation theorem – Regularity properties of Borel measures – Lebesgue measure – continuity properties of measurable functions

#### **UNIT IV : FOURIER TRANSFORMS**

Formal properties – Inversion theorem – The Plancherel theorem – Banach Algebra  $L^1$

#### **UNIT V : RIEMANN MAPPING THEOREM**

Preservation of angles – Linear fractional transformations – Normal families - Riemann Mapping Theorem

#### **TEXT BOOKS**

1. Serge Lang, "Algebra", Springer - Verlag, Revised Third Edition, 2002.  
Unit – I - Chapter III: Sections 1 to 6  
Unit – II - Chapter X: Sections 1 to 4.

2. W. Rudin, Real and Complex Analysis, 3<sup>rd</sup> edition, McGraw Hill International, 1986.  
Unit III – Chapter 2  
Unit IV – Chapter 9  
Unit V - Chapter 14 Pages 278-289

## **REFERENCES**

1. C. Musili, Rings and Modules, 2<sup>nd</sup> edition, Narosa, 1994.
2. P.B. Bhattacharya et al., Basic Abstract Algebra, 2<sup>nd</sup> edition, Cambridge University Press, 1995.
3. Serge Lang, Complex Analysis, Addison Wesley, 1977.
4. V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005.
5. C.D. Aliprantis and O.Burkinshaw, Principles of Real Analysis 2edn, Academic Press, Inc. New York, 1990.

## **Course Outcomes :**

- Students should become familiar with rings and fields and understand the structure theory of modules over a Euclidean domain along with its implications.
- It should give a good background for studying these more advanced topics.
- Define and recognize the basic properties of the rings of real numbers.
- Ability to apply the theorem in a correct mathematical way.
- To know the various theorems and their mathematical concepts.
- To document insight in modern theory of integration as a tool in advanced analysis in statistics.
- Have a fundamental understanding of Fourier transforms.
- To develop mathematical intuition and problem solving capabilities.
- To apply Laplace and inverse Laplace transforms to different applications.
- To be able to investigate the concepts of transformations.
- To use Riemann mapping theorem in applications.

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## **COURSE III**

### **Teaching and Learning Skills**

#### **Course Objectives :**

- Acquaint different parts of computer system and their functions.
- Understand the operations and use of computers and common Accessories.
- Develop skills of ICT and apply them in teaching learning context and Research.
- Appreciate the role of ICT in teaching, learning and Research.
- Acquire the knowledge of communication skill with special reference to its elements, types, development and styles.
- Understand the terms communication Technology and Computer mediated teaching and develop multimedia /e- content in their respective subject.
- Understand the communication process through the web.
- Acquire the knowledge of Instructional Technology and its Applications.
- Develop different teaching skills for putting the content across to targeted audience.

#### **Unit I : Computer Application Skills**

Information and Communication Technology (ICT): Definition, Meaning, Features, Trends – Integration of ICT in teaching and learning – ICT applications: Using word processors, Spread sheets, Power point slides in the classroom – ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations-- **ICT for Professional Development**: Concept of professional development; institutional efforts for competency building; individual learning for professional development using professional networks, OERs, technology for action research, etc.

#### **Unit II : Communications Skills**

Communication: Definitions – Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication: Spoken and Written; Non-verbal communication – Intrapersonal, interpersonal, Group and Mass communication – Barriers to communication: Mechanical, Physical, Linguistic & Cultural – Skills of communication: Listening, Speaking, Reading and Writing – Methods of developing fluency in oral and written communication – Style, Diction and Vocabulary – Classroom communication and dynamics.

#### **Unit III : 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: Characteristics, Principles, planning Implementation and Evaluation – Teaching-learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion.

## **Unit IV : E- Learning, Technology Integration and Academic Resources in India**

Concept and types of e-learning (synchronous and asynchronous instructional delivery and means), m-learning (mobile apps); blended learning; flipped learning; E-learning tools (like LMS; software's for word processing, making presentations, online editing, etc.); subject specific tools for e-learning; awareness of e-learning standards- Concept of technology integration in teaching- learning processes; frameworks guiding technology integration (like TPACK; SAMR); Technology Integration Matrix- Academic Resources in India: MOOC, NMEICT; NPTEL; e-pathshala; SWAYAM, SWAYAM Prabha, National academic depository, National Digital Library; e-Sodh Sindhu; virtual labs; eYantra, Talk to a teacher, MOODLE, mobile apps, etc.

## **Unit V : Skills of Teaching and Technology based assessment**

Teaching skills: Definition, Meaning and Nature- Types of Teaching 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- **Technology for Assessment:** Concept of assessment and paradigm shift in assessment; role of technology in assessment 'for' learning; tools for self & peer assessment (recording devices; e-rubrics, etc.); online assessment (open source software's; e-portfolio; quiz makers; e- rubrics; survey tools); technology for assessment of collaborative learning like blogs, discussion forums; learning analytics.

## **References**

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi
2. Brandon Hall , E-learning, A research note by Namahn, found in: [www.namahn.com/resources/ .../note-e-learning.pdf](http://www.namahn.com/resources/.../note-e-learning.pdf), Retrieved on 05/08/2011
3. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh
4. Information and Communication Technology in Education: A Curriculum for schools and programmed of Teacher Development, Jonathan Anderson and Tom Van Weert, UNESCO, 2002.
5. Jereb, E., & Šmitek, B. (2006). Applying multimedia instruction in e-learning. Innovations in Education & Teaching International, 43(1), 15-27.
6. Kumar, K.L. (2008) Educational Technology, New Age International Publishers, New Delhi.
7. Learning Management system : [https://en.wikipedia.org/wiki/Learning\\_management\\_system](https://en.wikipedia.org/wiki/Learning_management_system) , Retrieved on 05/01/2016
8. Mangal, S.K (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana.
9. Michael,D and William (2000), Integrating Technology into Teaching and Learning: Concepts and Applications, Prentice Hall, New york.

10. Pandey,S.K (2005) Teaching communication, Commonwealth Publishers, New Delhi.
11. Ram Babu,A abd Dandapani,S (2006), Microteaching (Vol.1 & 2), Neelkamal Publications, Hyderabad.
12. Singh,V.K and Sudarshan K.N. (1996), Computer Education, Discovery Publishing Company, New York.
13. Sharma,R.A., (2006) Fundamentals of Educational Technology, Surya Publications,Meerut
14. Vanaja,M and Rajasekar,S (2006), Computer Education, Neelkamal Publications, Hyderabad.

### **Course Outcomes**

After completing the course, the students will:

- Develop skills of ICT and apply them in Teaching Learning context and Research.
- Be able to use ICT for their professional development.
- Leverage OERs for their teaching and research.
- Appreciate the role of ICT in teaching, learning and Research.
- Develop communication skills with special reference to Listening, Speaking, Reading and Writing.
- Learn how to use instructional technology effectively in a classroom.
- Master the preparation and implementation of teaching techniques.
- Develop adequate skills and competencies to organize seminar / conference / workshop / symposium / panel discussion.
- Develop skills in e-learning and technology integration.
- Have the ability to utilize Academic resources in India for their teaching.
- Have the mastery over communication process through the web.
- Develop different teaching skills for putting the content across to targeted audience.
- Have the ability to use technology for assessment in a classroom.

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