PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY
(UNDER SEC.3 OF THE UGC ACT, 1956)

M.Phil (MATHEMATICS) – CURRICULUM (Full Time)

REGULATION 2018

Semester	Course Code	Course Title	Lecture	Seminar	Practical	Credit	Hours
I	ZMA101	Research Methodology	4	2	0	6	6
	ZMA102	Algebra & Analysis	4	2	0	6	6
	ZMA103	Differential Equations	4	2	0	6	6
						Total Credits: 18	**18**

Semester	Course Code	Course Title	Lecture	Seminar	Practical	Credit	Hours
II	ZMA201*	Guide Paper	1	3	0	4	4
	ZSW202	Teaching and Learning Skills	1	2	0	2	3
	ZMA202	Research Project - Dissertation	0	0	12	16*	12
						Total Credits: 22	**19**

***Guide Paper**

S.NO	Course Code	Course Title
1.	ZMA201A	Advanced Graph Theory
2.	ZMA201B	An Introduction to Category theory and Algebraic Graph theory
3.	ZMA201C	Fuzzy sets, Fuzzy logic & Category of Fuzzy sets
4.	ZMA201D	Fuzzy sets and Fuzzy logic
5.	ZMA201E	Linear Algebra and its Applications
6.	ZMA201F	Markov Chains and Time Series

*** 12 credits – Thesis; 4 credits – Viva-voce** **Total Credits: 40**

COURSE CODE	COURSE NAME	L	S	P	C
ZMA101	RESEARCH METHODOLOGY	4	2	0	6

Unit 1: RESEARCH METHODOLOGY: AN INTRODUCTION	**18**
Meaning of research – Objectives of research – Motivation in research – Types of research – Research approaches – Significance of research – Research methods versus Methodology – research and scientific method – research process – Criteria of Good Research.	
Unit 2: RESEARCH METHODOLOGY	**18**
What is Research problem? – Selecting the problem – Necessity of Defining the problem – Technique Involved in Defining a problem.	
unit 3: RESEARCH DESIGN	**18**
Meaning of Research Design – Need for Research design- Features of a Good Design – Important concepts relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs.	
Unit 4: ALGORITHMIC RESEARCH	**18**
Algorithmic research problems – Types of solution procedure – steps of Development of Algorithm – Steps of Algorithm Research – Design of Experiments and Comparison of Algorithm Meta Heuristic for Combinatorial problems.	
Unit 5: PEDAGOGY AND TEACHING SKILL	**18**
Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a lecture – Lecture with power point presentation - Teaching skill: 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.	

LECTURE	SEMINAR	TOTAL
60	30	90

REFERENCE BOOKS:

1. Anderson, Berny H. Dujrston, H. Pode, "Thesis & Assignment Writing", Wiley Eastern Ltd., New Delhi, 1970.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest, "Introduction to algorithms", Prentice Hall 1990.
3. Panneerselvam, R. "Research Methodology" , PHI, New Delhi 2005
4. Mangal, S.K., "Essential of Teaching – Learning and Information Technology", Tandon Publications, Ludhiana, 2002.
5. Michael D. and William, "Integrating Technology into Teaching and Learning: Concepts and Application"s, Prentice Hall, New York, 2000.
6. Pandey S.K., "Teaching Communication", Commonwealth Publishers, New Delhi, 2005.

COURSE CODE	COURSE NAME	L	S	P	C
ZMA102	ALGEBRA AND ANALYSIS	4	2	0	6

Unit 1: MODULES	**18**
Basic definitions – Group of homomorphisms – Direct products and sums of modules – Free modules – Vector spaces – The dual space and dual module.	
Unit 2: NOETHERIAN RINGS	**18**
Basic criteria – Associated primes – Primary decomposition - Nakayama's lemma.	
Unit 3: RIESZ REPRESENTATION THEOREM	**18**
Topological preliminaries - Riesz representation theorem – Regularity properties of Borel measures –Lebegue measure – continuity properties of measurable functions.	
Unit 4: FOURIER TRANSFORSMS	**18**
Formal properties – Inversion theorem – The Plancherel theorem – Banach Algebra L^1	
Unit 5: RIEMANN MAPPING THEOREM	**18**
Preservation of angles – Linear fractional transformations – Normal families - Riemann Mapping Theorem.	

LECTURE	SEMINAR	TOTAL
60	30	90

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", 3rd edition, McGraw Hill International,1986.
   Unit III – Chapter 2; Unit IV – Chapter 9; Unit V - Chapter 14

REFERENCES:

1. C. Musili, "Rings and Modules", 2nd edition, Narosa, 1994.
2. P.B. Bhattacharya et al., "Basic Abstract Algebra", 2nd edition, Cambridge University Press, 1995.
3. Serge Lang," Complex Analysis", Addison Wesley, 1977.
4. V. Karunakaran, "Complex Analysis", 2nd edn, Narosa, New Delhi, 2005.
5. NMEICT repository
6. http://nptel.ac.in/courses

COURSE CODE	COURSE NAME	L	S	P	C
ZMA103	DIFFERENTIAL EQUATIONS	4	2	0	6

Unit 1: LINEAR SYSTEMS **18**

Uncoupled Linear systems – Diagonalization – Exponentials of operators – Fundamental theorem for Linear systems – Linear Systems in R 2 – Complex eigen values – Multiple eigen values – Jordan forms – Stability theory.

Unit 2: NON LINEAR SYSTEMS **18**

Some preliminary concepts and definitions – The fundamental existence–uniqueness theorem – The maximal interval of existence – The flow defined by differential Equation.

Unit 3: GREEN'S FUNCTION AND STURM – LIOUVILLE PROBLEMS **18**

Solutions of second order linear equations – Boundary value problems and Green's function – Sturm-Liouville problems – Convergence in the mean – Integral operator with continuous symmetric kernel – Completeness of eigen functions of Sturm-Liouville problems – Non homogeneous integral equations – Properties of eigen values and eigen functions.

Unit 4: PARTIAL DIFFERENTIAL EQUATIONS **18**

The Heat equation – Maximum Principle – Initial Value problem – Laplace Equation – Boundary value problems – Green's Identity and Uniqueness theorem - Maximum Principle – Green's function for Laplace's Equations.

Unit 5: THE WAVE EQUATION **18**

The one-dimensional wave equation – Higher dimensions – Energy methods – Lower-order terms.

LECTURE	SEMINAR	TOTAL
60	30	90

TEXT BOOKS

1. Perko, L. Differential Equations and Dynamical systems, Springer-Verlag, New-York, 1991.
   Unit I – Chapter 1 – 1.1 to 1.10
   Unit II – Chapter 2 - 2.1 to 2.5
2. Chi Y. Lo, Boundary Value Problems, Allied-Publishers Pvt Ltd, 2003.
   Unit III – Chapter 3 – 3.1 to 3.9 5
   Unit IV – Chapter 5 – 5.2,5.5 Chapter 6 – 6.1, 6.2, 6.3, 6.7
3. Robert C. McOwen, Partial Differential Equations, Pearson Education, First Indian Reprint, 2004.
   Unit V - Chapter 3 – 3.1 to 3.4

REFERENCES:

1. Phoolan Prasad and Renuka Ravindran, "Partial Differential Equations", Wiley-Eastern Ltd, 1987.
2. Sharma, J.N. and Kehar Singh, "Partial Differential Equations for Engineers and Scientists", Narosa Publishing House, New Delhi, 2001.
3. Williams, W.E. "Partial Differential Equations", Clarender Press, Oxford, 1980.

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COURSE CODE	COURSE NAME	L	S	P	C
ZMA201A	ADVANCED GRAPH THEORY	1	3	0	4

Unit 1: CONNECTIVITY IN GRAPHS — **12**

Vertex connectivity – Edge connectivity – Blocks – k-connected and k-edge connected graphs – Network flow problems.

Unit 2: COLORING OF GRAPHS — **12**

Vertex colorings and upper bounds – Brooks' theorem – Graphs with large chromatic number – Turan's theorem – Counting proper colorings – Edge colouring – Characterization of line graphs.

Unit 3: PLANAR GRAPHS — **12**

Embeddings and Euler's formula – Dual graphs – Kuratowski's theorem – 5 colour theorem – Crossing number.

Unit 4: RAMSEY THEORY — **12**

The pigeonhole principle – Ramsey's theorem – Ramsey numbers – Graph Ramsey theory. The characteristic polynomial – Linear algebra of real symmetric matrices – Eigenvalues and graph parameters – Eigenvalues of regular graphs.

Unit 5: GRAPH LABELING — **12**

Types of labeling – graceful labeling – harmonious labeling – odd graceful, even graceful, magic labeling.

LECTURE	SEMINAR	TOTAL
15	45	60

TEXT BOOK:

1. Douglas B. West, "Introduction to Graph Theory", Prentice Hall of India, Second Edition, 2002.

REFERENCES

1. Bondy J. A, and Murty U. S. R., "Graph Theory", Springer, 2008.
2. Balakrishnan R. and Ranganathan K., "A textbook of Graph Theory", Springer, 2012.
3. Graham R.L., Rothschild B.L and Spencer J.H., "Ramsey Theory", Wiley Publishers, Second Edition, 1990.
4. Biggs N., "Algebraic Graph Theory", Cambridge University Press, 1994.

COURSE CODE			COURSE NAME	L	T	P	C
ZSW202			TEACHING LEARNING SKILLS	1	2	0	2
C	P	A					

2	**0**	**0**		**L**	**T**	**P**	**H**
				1	**2**	**0**	**3**

PREREQUISITE: Nil

COURSE OUTCOMES:

Course outcomes	**Domain**	**Level**
CO1: Define and Explain the role of a teacher in different phases of teaching.	Cognitive	Remembering Understanding
CO2: Define and Explain various micro teaching skills.	Cognitive	Remembering Understanding
CO3: Define and Explain the Learning and different methods of teaching.	Cognitive	Remembering Understanding
CO4: Define and Explain the importance of teaching devices and techniques.	Cognitive	Remembering Understanding
CO5: ***Apply*** the concept and **solve** the problems using SPSS.	Cognitive	Applying

UNIT I CONCEPT OF TEACHING **6**

Teaching- an art or a science? - Relationship between Teaching and Learning. Analysis of the concept of Teaching - Teaching as a deliberately - planned process: Analysis in terms of teaching skills - General Model of instruction – Pre active, Interactive and Post active - phases and Teachers role in them.

UNIT II SKILLS IN TEACHING **6**

Microteaching skills – need, procedure, cycle of operations and uses – set induction, stimulus variation, reinforcement, questioning, illustrating, explaining demonstrating, using black board, link lesson and closure

UNIT III CONCEPTS OF LEARNING **6**

Nature and importance of learning – Individual differences in learning - Learning Curves- Factors influencing the learning- theories of learning - Transfer of Learning- Learning by Imitation.

UNIT IV TECHNIQUES OF TEACHING-LEARNING – LARGE GROUP **6**

Lecturing - Place in Higher Education - Purposes served - Basic skills - Evaluation of Effectiveness. Demonstration - Video conferencing - Method of organizing - Advantages and disadvantages as a teaching learning process. Use of Audio Visual Aids – Importance - General Principles of use - Advantages and disadvantages.

Techniques of teaching-learning – Small group

Importance, Skills of using, Evaluation of Effectiveness of the following:

Group discussion - Collaborative learning - Seminar - Debate - Group investigation - Role play.

UNIT V INTRODUCTION TO SPSS	**6**

Introduction to SPSS - Data analysis with SPSS: general aspects, workflow, critical issues - SPSS: general description, functions, menus, commands - SPSS file management.

LECTURE	**TUTORIAL**	**TOTAL**
10	**20**	**30**

REFERENCES

1. Davis, Irork (1971), The Management of learning, McGraw Hill, London.
2. Judith, I. (2008). Learners, learning and educational activity. London: Routledge.
3. Graham, R. (2008). Psychology: The key concepts. London: Routledge.
4. Samuel, W. (2007). The intellectual and moral development of the present age. U.S: Kessing Pub Co.
5. Chobra, R. K. (2006). Elements of educational psychology. New Delhi: Arise Publishers.
6. Langer, J. and Applebee, A.N. (1987). How writing shapes thinking: A Study of Teaching and Learning, National Council of Teachers of English.
7. Lindfors, J. (1984). How children learn or how teachers teach? A Profound confusion: Language Arts, 61 (6), 600-606.
8. Vygotsky, L.S. Thought and Language, Cambridge, MA: MIT Press, 1962.
9. Field A., Discovering Statistics Using SPSS, Fourth Edition, SAGE, 2013

Resource Websites:

- http://www.thirteen.org/edonline/concept2class/constructivism/index.html.
- www.ipn.uni-kiel.de/projekte/esera/book/b001-cha.pdf
- http://www.ericdigests.org/1999-3/theory.htm
- http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at6lk36.htm
- http://saskschoolboards.ca/research/instruction/97-07.htm

- http://www.ed.psu.edu/CI/Journals/1998AETS/t1_7_freeman.rtf
- http://en.wikipedia.org/wiki/Constructivist_teaching_methods
- http://www.ncrel.org/sdrs/areas/issues/envrnmnt/drugfree/sa3const.htm
- http://vathena.arc.nasa.gov/project/teacher/construc.html
- http://www.grout.demon.co.uk/Barbara/chreods.htm
- http://vathena.arc.nasa.gov/project/document/teacher.html
- http://www.disciplineassociates.com/ClassroomDiscipline_101.aspx

COURSE CODE	COURSE NAME	L	S	P	C
ZMA201B	AN INTRODUCTION TO CATEGORY THEORY AND ALGEBRAIC GRAPH THEORY	1	3	0	4

Unit 1: INTRODUCTION TO CATEGORY OF SETS	**12**
Definition- Examples, Category of sets, Duality, Special Morphisms, Equalizers, Pullbacks, Pushouts, Intersection, Union, Kernels, Normality, Images and Inverse Images, Products & Co products Monoids, Functors, Graphs & Ologs.	
Unit 2: DIAGRAMS & FUNCTORS, OLOGS	**12**
Morphism Functors, Limit preserving Functors, Faithful Functors, Natural Transformation, Equivalence of Categories	
Unit 3: GRAPHS	**12**
Graphs-subgraphs-Automorphisms-Homomorphisms-Circulant Graphs-Johnsons Graphs-Line Graphs-Planar Graphs	
Unit 4: TRANSITIVE GRAPHS	**12**
Vertex Transitive Graphs-Edge Transitive Graphs-Edge connectivity-Vertex Connectivity-Matchings- Hamilton paths and cycles-Cayley Graphs-Directed cayley graphs with no Hamilton cycles-retracts-transpositions.	
Unit 5: HOMOMORPHISMS	**12**
The Basics-Cores-Products-The Map Graph-Counting Homomorphism-Products and Colorings-Uniquely Colorable Graphs-Foldings and Covers-Cores with No Triangles-Cores of Vertex Transitive Graphs- Cores of Cubic Vertex Transitive graphs.	

LECTURE	SEMINAR	TOTAL
15	45	60

TEXT BOOKS:

1. Saunders Mac Lane , "Categories for the working Mathematician", second edition, 1978.

2. Chris Godsil Gordon Royle, "Algebraic Graph Theory", 1st edition, Springer Science and business media, New York, 2001.

REFERENCES:

1. Barry Mitchell, "Theory of Categories", volume 17, Academic Press, January, 1965.
2. David I. Spivak., "Category theory for the Sciences", the MIT Press, Cambridge Massachusetts, London, England, 1978.

COURSE CODE	COURSE NAME	L	S	P	C
ZMA201C	FUZZY SETS, FUZZY LOGIC & CATEGORY OF FUZZY SETS	1	3	0	4

Unit 1: INTRODUCTION TO CATEGORY OF SETS	**12**
Definition- Examples, Category of sets, Duality, Special Morphisms, Equalizers, Pullbacks, Pushouts, Intersection, Union, Kernels, Normality, Images and Inverse Images, Products & Co products Monoids, Functors, Graphs & Ologs.	
Unit 2: DIAGRAMS & FUNCTORS, OLOGS	**12**
Morphism Functors, Limit preserving Functors, Faithful Functors, Natural Transformation, Equivalence of Categories	
Unit 3: CATEGORY OF FUZZY SETS	**12**
Fuzzy sets, Fuzzy logic , Category of Fuzzy sets Understand the concepts of Fuzzy Sets, Definition- Examples, Crispness, Vagueness, Fuzziness, Uncertainity, Types, Principles.	
Unit 4: FUZZY DECISION MAKING ENVIRONMENT	**12**
Decision Making in Fuzzy Environment by using various types of models, Multi objective decision making(MODM), Attribute decision making(MADM)	
Unit 5: APPLICATIONS	**12**
Applications of Categorical Structures & Fuzzy sets, Fuzzy Logic in science , Engineering & Management	

LECTURE	SEMINAR	TOTAL
15	45	60

TEXT BOOKS:

1. Saunders Mac Lane , "Categories for the working Mathematician", second edition, 1978.
2. H. J. Zimmermann," Fuzzy Set Theory & its Applications" Fourth Edition, Springer I,1899.

REFERENCES:

1 Barry Mitchell, "Theory of Categories", volume 17, Academic Press, January, 1965.

2. David I. Spivak , "Category theory for the Sciences", the MIT Press, Cambridge Massachusetts, London, England, 1978.
3. Timothy. J. Ross "Fuzzy Logic With Engineering Applications", Third Edition, John Wiley and Sons, Ltd.,2010.

COURSE CODE	COURSE NAME	L	S	P	C
ZMA201 D	FUZZY SETS AND FUZZY LOGIC	1	3	0	4
Unit 1: CRISP SETS AND FUZZY SETS					**12**
Crisp sets basic definitions - the notion of fuzzy sets - basic concepts of fuzzy sets.					
Unit 2: OPERATION ON FUZZY SETS					**12**
Fuzzy complement - fuzzy union - fuzzy intersection - combination and general aggregation operations.					
Unit 3: FUZZY RELATIONS					**12**
Crisp and fuzzy relations - binary relation - equivalence and similarity relations - tolerance relations - orderings.					
Unit 4: CLASSICAL LOGIC					**12**
Tautologies - contradictions - equivalence - exclusive OR and exclusive NOR - logical proofs.					
Unit 5: FUZZY LOGIC					**12**
Fuzzy logic - approximate reasoning - fuzzy tautologies - contradictions - equivalence and logical proofs.					

LECTURE	SEMINAR	TOTAL
15	45	60

TEXT BOOKS:

1. George J. Klir & Tina A. Folger, "Fuzzy Sets, Uncertainty, and Information", Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

2. Timothy. J. Ross "Fuzzy Logic With Engineering Applications", Third Edition, John Wiley and Sons, Ltd.,2010.

REFERENCES:

1. Zimmermann. H.J, Fuzzy Set Theory and Its Applications, 4^{th} edition, Springer, I, 1899.
2. Bart Kosko, Neural Networks and Fuzzy Systems, Prentice-Hall International, 1992.

COURSE CODE	COURSE NAME	L	S	P	C
ZMA 201E	LINEAR ALGEBRA AND ITS APPLICATIONS	1	3	0	4

Unit 1: LINEAR EQUATIONS & VECTOR SPACES **12**

Fields-Systems of Linear equations-Matrices and Elementary Row Operations-Row Reduced Echelon Matrices-Matrix Multiplication-Invertible Matrices-Vector Spaces-Subspaces-Bases and Dimension-Co-ordinates.

Unit 2: LINEAR TRANSFORMATIONS & POLYNOMIALS **12**

Linear Transformations-The Algebra of Linear Transformations-Isomorphism-Representation of Transformations by matrices-Linear Functionals-The Double dual –The transpose of Linear Transformation-Algebras-The Algebra of Polynomials-Lagrange Interpolation-Polynomial Ideals-The prime Factorisation of a polynomial.

Unit 3: DETERMINANTS & ELEMENTARY CANONICAL FORMS **12**

Commutative Rings-Determinant Functions-Permutations and the Uniqueness of Determinants-Additional Properties of Determinants-Modules-Multilinear Functions-The Grassman Ring - Introduction-Characteristic values-Annihilating Polynomials-Invariant Subspaces-Simultaneous Triangulation- Simultaneous Diagonalisation-Direct sum Decompositions-Invariant Direct sums-The Primary Decomposition Theorem.

Unit 4: THE RATIONAL , JORDAN FORMS & INNER PRODUCT SPACES **12**

Cyclic subspaces and Annihilators- cyclic Decompositions and the Rational Form-The Jordan Form-Computation of Invariant Factors- Inner Products- Inner Product Spaces-Linear Functionals and Adjoints-Unitary Operators-Normal Operators.

Unit 5: OPERATORS ON INNER PRODUCT SPACES& BILINEAR FORMS **12**

Introduction-Forms on Inner Product Spaces-Positive Forms-More on Forms-Spectral Theory-Further Properties of Normal Operators - Bilinear Forms-Symmetric Bilinear Forms-Skew-Symmetric Bilinear Forms-Groups preserving Bilinear Forms.

LECTURE	SEMINAR	TOTAL
15	45	60

TEXT BOOK:

1. Kenneth Hoffman and Ray Kunze , “Linear Algebra”, Second Ed., PHI, 1971
   Unit I : Chapter I & II
   Unit II **:** Chapter III & IV
   Unit III**:** Chapter V& VI
   Unit IV**:** Chapter VII & VIII
   Unit V **:** Chapter IX & X

COURSE CODE	COURSE NAME	L	S	P	C
ZMA201F	MARKOV CHAINS AND TIME SERIES	1	3	0	4

Unit 1: **12**

A Review of probability Theory and Distributions Laws of Probability – Discrete and Continuous distributions – Moment generating function – Joint distribution and Conditional Expectation.

Unit 2: **12**

Elements of Stochastic Process and its classifications – Poisson process – Renewal process.

Unit 3: **12**

Markov Chain and Markov Processes – Detailed Study of Poisson process, Pure Birth process, Yule's process, Birth and death process-Application to queues.

Unit 4: **12**

Stochastic models for Time Series - General linear filter model-Autoregressive (AR (p)) models - Moving average model (MA(q)) - Autoregressive - Moving average (ARMA(p,q)) models - Autoregressive integrated moving average model (ARIMA(p,d,q)).

Unit 5: **12**

Analysing Time Series Model: Spectral Density of AR models, MA, ARMA, models. Relationship between Auto covariance and spectral density - Cyclical Behaviour finding Auto covariance, Auto correlation through Spectral Density. Analysing Spectral Graph-Analysing the Cyclic Behaviour of Time Series - Spectral Density and Linear Filters. Relationship between Markov Process and Time Series - Co integrated Time Series.

LECTURE	SEMINAR	TOTAL
15	45	60

REFERENCES:

1. Sheldon M. Ross," Introduction to Probability Models", Academic Press, Eighth Edition, 2005.
2. Bhat. U.N, "Elements of Applied Stochastic Processes", Wiley 1972.
3. Karlin.S and Taylor, "A first course in Stochastic Processes", Academic Press, New York. 1975.
4. Methi.J, Stochastic Processes, Wiley Eastern, 2nd ed, 1994.

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