BHARATHIDASAN UNIVERSITY

TIRUCHIRAPPALLI – 620 024

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

(For the candidates to be admitted from the academic year 2007-2008 onwards)

Semester I

	Title of the Course	Marks			Credits
		IA	UE	Total	
Course -I	Advanced Algebra	25	75	100	4
Course - II	Advanced Analysis	25	75	100	4
Course- III	Differential Equations	25	75	100	4

Semester II

Course – IV	Elective (Any one)	25	75	100	4

1. Fuzzy sets and systems
2. Advanced Topics in Graph Theory
3. Algebraic Number Theory
4. Advanced Numerical Analysis

Dissertation and Viva-Voce		200	8
Viva Voce 50 marks			
Dissertation 150 marks			

QUESTION PAPER PATTERN (Course I – IV)

Part - A: Two questions from each unit (without choice). Each question carries 2 marks. (10 x 2 = 20)

Part – B: One "EITHER OR" questions from each unit Each question carries 5 marks (5 x5 = 25).

Part – C: One question from each unit. Each question carries 10 marks. The candidate has to answer three questions out of the five questions (3 x 10 = 30)

COURSE – I

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 contravariant 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

Integral ring extensions – Integral Galois extensions.

UNIT V

Basic Criteria for a Noetherian module– Associated primes – Primary decomposition – Nakayama's lemma.

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-singular varieties 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 C coefficients and the theory of Lie groups
(ii) example on Page 134 relating to the category of complexes of modules over a ring, vector bundles over a topological space and sheaves of abelian groups over a topological space.

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

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

COURSE – II

ADVANCED ANALYSIS

UNIT I

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

UNIT II

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

UNIT III

L^p spaces: Convex functions and inequalities – The L^p spaces – Approximation by continuous functions

UNIT IV

Fourier transforms: Formal properties – Inversion theorem – The Plancherel theorem

UNIT V

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

TEXT BOOKS

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

Unit I – Chapter I
Unit II – Chapter 2
Unit III – Chapter 3
Unit IV – Chapter 9
Unit V - Chapter 14 Pages 278-289

REFERENCE(S)

[1] Serge Lang, Complex Analysis, Addison Wesley, 1977.

[2] V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005.

COURSE– III

DIFFERENTIAL EQUATIONS

UNIT – I

Linear Systems: 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 – Non-homogeneous linear systems.

UNIT – II

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

UNIT – III

Green's Function and Sturm – Liouville problems: 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 – IV

Partial Differential Equations : 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 – V

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

TEXT BOOK(S):

1. L. Perko, 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

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. J.N. Sharma and Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, New Delhi, 2001.
3. W.E. Williams, Partial Differential Equations, Clarender Press, Oxford, 1980.
4. Garrett Birkhoff, Gian-Carlo Rota, Ordinary Differential Equations, IV Edn. John Wiley & Sons.

COURSE – IV (Elective)

FUZZY SETS AND SYSTEMS

UNIT – I

Fuzzy sets – Basic types – Basic concepts – α-cuts – Additional properties of α-cuts – Extension principle for Fuzzy sets.

UNIT – II

Operations on Fuzzy sets – Types of operations – Fuzzy complements – t-Norms – Fuzzy Unions – Combinations of operations.

UNIT – III

Fuzzy Arithmetic – Fuzzy numbers – Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers.

UNIT – IV

Fuzzy relations – Binary fuzzy relations – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Fuzzy morphisms.

UNIT - V

Fuzzy Relation Equations – General discussion – Problem partitioning – Solution method – Fuzzy Relation Equations based on Sup-i Compositions - Fuzzy Relation Equations based on inf-ω_i Compositions.

TEXT BOOK

[1] **George J.Klir and B. Yuan**, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004.

Unit I Chapter 1 and 2

Unit II Chapter 3

Unit III Chapter 4

Unit IV Chapter 5

Unit V Chapter 6

REFERENCE(S)

[1] H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991.

COURSE – IV (Elective)

ADVANCED TOPICS IN GRAPH THEORY

UNIT I

Perfect graphs

UNIT II

Other classes of Perfect graphs

UNIT III

Labelings of graphs

UNIT IV

Factorizations and decompositions.

UNIT V

Domination in graphs

Text Books:

[1] D.B. West, Introduction to graph theory , PHI (2002),

Unit – I & II – Chapter 8.1

[2] G.Chartrand and L.Lesniak, Graphs and Digraphs, Chapen & Hall/ CRC Press, 1996.
Unit – III – Chapter 9 Section 3
Unit – IV - Chapter 9 Section 2
Unit – V - Chapter 10 Sections 1 and 2

REFERENCE(S)

[1] J.Clark and D.A.Holton, A First look at Graph Theory, Allied Publishers, New Delhi, 1995.

[2] R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.

[3] A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.

[4] R.J..Wilson. and J.J.Watkins, Graphs: An Introductory Approach, John Wiley and Sons, New York, 1989.

[5] K.R. Parathasarathy, Basic Graph Theory, Tata Mc-Graw Hill Publishing Company, New Delhi, 1994

COURSE – IV (Elective)

ALGEBRAIC NUMBER THEORY

UNIT I

Algebraic background: Rings and fields - Factorization of polynomials - Field extensions - Symmetric polynomials - Modules - Free abelian groups

UNIT II

Algebraic numbers: conjugates and discriminants - Algebraic integers - Integral bases - Norms and traces

UNIT III

Quadratic fields - Cyclotomic fields - Factorization into irreducibles - examples of non-unique factorization into irreducibles

UNIT IV

Prime factorization - Euclidean domains - Euclidean quadratic fields - consequences of unique factorization - the Ramanjuan- Nagell theorem

UNIT V

Fractional Ideals - Prime factorization of ideals - The norm of an ideal.

TEXT BOOK

[1] Ian Stewart and David Tall - Algebraic Number Theory, Chapman and Hall Mathematics Series (1979).
Unit I: Chapter 1
Unit II: Chapter 2
Unit III: Chapter 3, and Sections 4.1 – 4.4 of Chapter 4
Unit IV: Sections 4.5 - 4.9 of Chapter 4
Unit V: Chapter 5.

COURSE – IV (Elective)

ADVANCED NUMERICAL ANALYSIS

UNIT – I

Transcendental and polynomial equations: Rate of convergence of iterative methods –Methods for finding complex roots – Polynomial equations – Birge-Vieta method, Bairstow's method, Graeffe's root squaring method.

UNIT – II

System of Linear Algebraic equations and Eigen Value Problems: Error Analysis of direct and iteration methods – Finding eigen values and eigen vectors – Jacobi and Power methods.

UNIT – III

Interpolation and Approximation : - Hermite Interpolations – Piecewise and Spline Interpolation – Bivariate Interpolation- Approximation – Least square approximation and best approximations.

UNIT - IV

Differentiation and Integration: - Numerical Differentiation - Optimum choice of Step- length – Extrapolation methods – Partial Differentiation – Methods based on undetermined coefficients – Gauss methods.

UNIT – V

Ordinary differential equations : Local truncation error – Euler, Backward Euler, Midpoint, Taylor's Method and second order Runge-Kutta method– Stability analysis.

TEXT BOOK(S):

[1] M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, III Edn. Wiley Eastern Ltd., 1993.

Unit I – Chapter 2 – 2.5 to 2.8
Unit II – Chapter 3 – 3.3, 3.4,3.5
Unit III – Chapter 4 – 4.5 to 4.9
Unit IV – Chapter 5 – 5.2, 5.3, 5.4, 5.5, 5.8
Unit V - Chapter 6 – 6.2, 6.3, 6.6

REFERENCES

[1] Kendall E. Atkinson, An Introduction to Numerical Analysis, II Edn., John Wiley & Sons, 1988.

[2] M.K. Jain, Numerical Solution of Differential Equations, II Edn., New Age International Pvt Ltd., 1983.

[3] Samuel. D. Conte, Carl. De Boor, Elementary Numerical Analysis, Mc Graw-Hill International Edn., 1983.