ANDHRA UNIVERSITY
Department of Mathematics
Pre-Ph. D./M.Phil. Mathematics
Revised Syllabi
(revised w.e.f. 2018-19 admitted batch)

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EIGHT questions are to be given. Answer any Five questions. Each question carries 20 marks.

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Paper -I: Selected Topics in Mathematics (Compulsory).

Paper-II : The candidate has to choose any one of the following papers.

- Boolean Algebra
- Fuzzy Algebra
- Mathematical Modelling
- Number Theory and Cryptography
- Nonlinear Functional Analysis
- Numerical Analysis

Andhra University
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Pre-Ph. D. / M. Phil. Examinations
Paper I –Selected Topic in Mathematics
(Revised w. e. f. the admitted batch 2018-2019)

Algebra

The Structure of Rings: Semi and Primitive Rings-The Jacobson Radical-Semi simple Rings-The Prime Radical-Prime and Semi prime Rings-Algebras-Division Algebras.
(Chapter IX of the Prescribed Text Book).

Prescribed Text Book: Thomas W. Hungerford,Algebra, Springer-Verlag, Second Indian Reprint 2005.

Real Analysis

Implicit functions and Extremum problems: Introduction-functions with non-zero Jacobian determinant-The inverse function theorem-The implicit function theorem-Extrema of real-valued functions of one variable-Extrema of real-valued functions of several variables-Extremum problems with side conditions.
(**Chapter 13 of the Prescribed Text Book)**

Prescribed Text Book: Tom M. Apostol, Mathematical Analysis, Addition-Wesley/Narosa, Indian student edition, Second edition, 1985

Topology

Convergence: Sequences of nets-Filterbases in spaces-Convergence properties of Filterbases-Closure in terms of Filterbases-Continuity, Convergence in Cartesian products-Adequacy of sequences-Maximal filterbases.
Homotopy: Homotopy-Homotopy classes-Homotopy and function spaces-Relative homotopy-Retracks and Extendability-DeformationRetraction and Homotopy-Homotopy and extendability-Applications.
(Chapter X and XV of the Prescribed Text Book.)

Prescribed Text Book: Topology, James Dugundji, Universal Book Stall, New Delhi.

DIFFERENTIAL EQUATIONS

Stability of Linear Systems – Introduction-Continuous dependence of solutions on initial conditions and parameters - stability properties of solutions- Linear systems-Two-dimensional systems
(Sections 3.1-3.3 and 3.5 of the text book).

Prescribed Text Book: Shair Ahmad, M. Rama Mohana Rao, Theory of Ordinary Differential Equations with applications in Biology and Engineering, Affiliated East-West Press Private Limited, 1999

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Pre – Ph. D. / M. Phil. Examinations
Paper II – Boolean Algebra
(Revised w. e. f. the admitted batch 2018-2019)

Boolean rings – Boolean algebras – Fields of sets – Regular open Sets – Elementary relations – Order – Infinite operations – Subalgebras – Homomorphisms – Free Algebras – Ideals and filters – The Homomorphism theorem – Boolean σ-algebras – The countable chain condition – Measure algebras – Atoms – Boolean spaces – The representation theorem – Duality for ideals – Duality for homomorphisms.

Prescribed Text Book: Lectures on Boolean Algebras, by Paul R. Halmos, D. Van Nostrand Company, Inc. Princeton, New Jersey.

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Pre – Ph. D. / M. Phil. Examinations
Paper II – Fuzzy Algebra
(Revised w. e. f. the admitted batch 2018-2019)

Union of two fuzzy sub groups – fuzzy sub group generated by a fuzzy subset – fuzzy normal sub groups fuzzy conjugate subgroups and fuzzy characteristic subgroups – fuzzy syllow subgroups.
(Chapter 2 of prescribed book)

Some elementary properties of fuzzy ideals – union of fuzzy subrings (fuzzy ideals) fuzzy subring (fuzzy ideal) generated by a fuzzy subset – fuzzy ideals and homomorhisms – fuzzy cosets
(Chapter 2 of prescribed book)

Fuzzy prime ideals fuzzy maximal ideals – fuzzy semiprime ideals – characterization of regularity
(Chapter 4 of prescribed book)

Fuzzy primary ideals – fuzzy semiprimary ideals definition and some properties – fuzzy ideals and fuzzy irreducible ideals in Noetherian ring.
(Chapter 5 & 6 of prescribed book)

Prescribed Text Book: Fuzzy algebra by Rajesh Kumar, University Press University of Delhi, Delhi – 110007.

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Paper II - MATHEMATICAL MODELLING
(Revised w. e. f. the admitted batch 2018-2019)

Single species models:

Exponential, logistic and Gompertz growth

Harvest models: bifurcations and break points

Interacting populations:

A classical predator – prey model, To cycle or not to cycle

Global bifurcations in predator-prey models, Chemostat models

Competition models, Mutualism models

(A.1-2, B.7-10, B.12-13 (excluding discrete dynamic models) of the Text book)

Prescribed Text Book: Mark Kot, 2001, Elements of Mathematical Ecology, Cambridge University press.

References: Nisbet and Gurney, 1982, Modelling Fluctuating Populations, John Wiley & Sons.

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Pre – Ph. D. / M. Phil. Examinations
Paper II : Nonlinear Functional Analysis
(Revised w. e. f. the admitted batch 2018-2019)

Results based on completeness: Banach Contraction Principle – Elementary domain Invariance - Continuation Methods for Contractive Maps – Nonlinear alternative for contractive Maps – Extensions of the Banach Theorem. Fixed point theorems in complete metric spaces. Extensions of the Banach theorem. **(Sections 1 to 5, 6A and 6B of I, § 1 of Text Book).**

Order- theoretic results: The Knaster-Tarski Theorem – Order and completeness, Theorem of Bishop – Phelps – Fixed Points for set-valued contractive maps – Applications to Geometry of Banach spaces – Applications to the theory of Critical Points. Fixed Points of Partially ordered sets.
(Sections 1 to 5 and 6A of I, § 2 of Text Book).

Results based on convexity: KKM- Maps and the Geometric KKM- Principle – Theorem of Non Neumann and systems of inequalities – Fixed points of Affine Maps, Markoff – Kakutani theorem – Fixed points for Families of maps, Theorem of Kakutani. **(Sections 1 to 4 of I, § 3 of Text Book).**

Further results and applications of Fixed Point theorems : Nonexpansive Maps in Hilbert space – Applications of the Banach Principle to Integral and Differential equations – Applications of the Elementary Domain Invariance – Elementary KKM – Principle and its applications – Theorems of Mazur – Orlicz and Hahn – Banach. **(Sections 1 to 5 of I, § 4 of Text Book).**

Prescribed Text Book : Andrzej Granas and James Dugundji : Fixed point theory, Springer, 2003.

Department of Mathematics
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Pre – Ph. D. / M. Phil. Examinations
Paper – II Numerical Analysis
(Revised w. e. f. the admitted batch 2018-2019)

Polynomial Interpolation – Function approximation, Polynomial interpolation, Finite differences, Newton's interpolation formulae, Least square curve fitting, Spline interpolation.
(Chapter 3, Section 3.1 – 3.4 and Chapter 7 Section 7.2 – 7.4 of the textbook)

Numerical solution of ordinary differential equations: Initial value problem: an example – existence and uniqueness of solutions, single and multi step methods, stability study, first order systems, numerical solution of non-linear systems – the problem, Picard iteration, Newton's method.
(Chapter 5 Section 5.1 – 5.5 and Chapter 8.1 – 8.3 of the textbook)

Finite difference methods of Partial differential equations: Parabolic type – Introduction, Characteristic and types of second order equations, well posed problems, some basic properties of linear and quasi-linear equations, system of first order equations, finite difference discretization, parabolic type equations, Crank – Nicholson implicit scheme.
(Chapter 9 Section 9.1 – 9.9 of textbook)

Equation of hyperbolic and elliptic type – hyperbolic type equations, FTCS and other explicit scheme, Lax Wendorf scheme.
(**Chapter 10 Section 10.1 – 10.3 of the textbook)**

Prescribed Text Book: Numerical Analysis and Algorithms, Pradip Niyogi, Tata McGraw Hill Publishing Company Limited, 2003.

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Paper-II – Number Theory and Cryptography
(Revised w.e.f. 2018-19 admitted batch)

Some topics in elementary number theory: Time estimates for doing arithmetic – Divisibility and
Euclidean algorithm – Congruence's – Some applications for factoring.
Chapter-I sections 1-4

Cryptography: Some simple Cryptosystems –Enciphering Matrices.
Chapter-III sections 1-2

Pubic Key: The idea of public key Cryptography – R.S.A. – Discrete logarithm Problem
Chapter -IV sections 1-3

Elliptic Curves: Basic facts – Elliptic Curve cryptosystems
Chapter- VI sections 1-2
Prescribed Text Book: A Course in Number Theory and Cryptography Author: Neal Koblitz.
Reference Book: Introduction to Cryptography Author: Johannes A. Buchmann