

**Pt. Ravishankar Shukla University, Raipur**  
**M.Phil. (Mathematics) (code – 619)**  
**2017-18 & Onward**

**Scheme of Examination**

There shall be three theory papers , one dissertation and seminar in M.Phil.(Mathematics). All are compulsory. Each theory paper will have 100 marks. The course content of each paper has been divided into five units. However, there will be internal choice in each Unit. Dissertation will be of 200 marks ((Script -100+ Viva Voce 100). Seminar will be of 100 marks (On dissertation -50 + On Theory Papers -50).

S.No.	Particulars			Max. Marks	
1	Theory Papers	Paper-I	Research Methodology, Quantitative techniques and Computers (Code 101)	100	300
		Paper-II	Cryptography (Code 102)	100	
		Paper-III	Nonlinear Analysis and Topological Structures (Code 103)	100	
2	Dissertation (Code 104)	Script		100	200
		Viva Voce		100	
3	Seminar (Code 105)	On dissertation		50	100
		On Theory Papers		50	
Grand Total					600

Guidelines of activities/academic calendar for M.Phil. Students:

1. The subject of dissertation will be provided by supervisor in the first week of September.
2. The dissertation has to be submitted by the end of first week of March. Thereafter supervisor will take no responsibility for delay in the submission of the dissertation.
3. Students are requested to complete the typing work (preferably in AMS-TeX/Latex) of their dissertation by the last week of February.
4. Every week on student will present his/her seminar using OHP/LCD based on the theory papers/on the subject assigned in the dissertation.

# Details of Syllabus

## Paper I

### Research Methodology, Quantitative techniques and Computers

M.M. 100

#### Unit I – Research Methodology:

Introduction to research methodology, Meaning, objectives, types, significance of Research. Identification, Selection of Research problem, Formulation of research objectives, Research design, components, importance and typology, Quantitative and qualitative methodology, hypotheses. Research ethics.

**Unit II - Scientific Writing :** Importance of Science Writing , Meaning and nature of Scientific Style , Writing effective scientific prose, Effective word selection in Science writing, Common mathematical functions and their abbreviations, Symbols, Operators Commonly used in Mathematics, Greek, Roman letters used in mathematics, Mathematical Theorems and properties, Mathematics Journals and their abbreviations.

#### Unit III - Style and Usage for Mathematics :

**Review :** Mathematics Subject Classifications (MSC). Mathematical Review, MathSciNet and other E-Resources.

#### Manuscript Preparation :

Structure of a Standard Mathematics Paper (in brief), Other Forms of Mathematics Manuscripts.

**Usage :** Mathematical Expressions, Alphabets used in Mathematical Expressions, Bracketing, Limits, Fractions, Multiplication, Vectors, Tensors, and n-forms, Summations, Products, Unions, and Integrals.

#### Unit IV - Typesetting Mathematical Text with LATEX :

Sample Document, Type Style, Environments, Lists, Centering, Tables, Verbatim, Vertical and Horizontal Spacing. Equation Environments, Fonts, Hats, and Underlining, Braces, Arrays and Matrices, Customized Commands, Theorem-like Environments, Math Styles, Document Classes and the Overall Structure, Titles for Documents, Sectioning Commands, Packages, Inputting Files, Inputting Pictures, Making a Bibliography, Making an Index, Slides.

#### Unit V - MATLAB :

Arithmetic Operations, built-in-MATH functions, scalar variables, Creating Arrays, built-in-functions for handling arrays, Mathematical Operations with Arrays, Script Files, Two dimensional plots, programming in MATLAB, Polynomial, curve fitting, and interpolation, Three-dimensional plots.

#### Books recommended :

1. C.R.Kothari, Research Methodology, New Age International Publishers (2004)
2. Michael Davis : Ethics and the University. Routledge (1999)
3. Harold Rabinowitz, Suzanne Vogel : The Manual of Scientific Style. Academic Press (2009)
4. Laslie Lamport : LATEX. Addison Wesley Publication Company (1994)
5. David F. Griffiths, Desmond J. Higham : Learning LATEX. Society for Industrial and Applied Mathematics, Philadelphia (1997)
6. Amos Gilat : MATLAB : An Introduction with Applications. John Wiley & Sons, INC (2004)

## Paper -II

### CRYPTOGRAPHY

**Note:** Each unit will be given weightage of 20 marks. Student will attempt one question from each unit. There will be internal choice in each unit.

**M.M. 100**

#### **UNIT 1: Fundamental concepts:**

Elements of number theory: Greatest Common Divisor, divisibility and Euclidean algorithm, Congruences, Semi-Groups, Groups, Residue Class Rings, Fields, Analysis of Operation in the Residue Class Rings, Fermat's Little Theorem, Fast Exponentiation, The Chinese Remainder Theorem, Time estimates for doing arithmetic, Polynomial time. Factoring concept.

#### Unit 2 – **Encryption process :**

Encryption, decryption and key generation. Symmetric and Asymmetric Crypto systems, Cryptanalysis, Alphabets and Words, Permutations, Block Ciphers, Multiple Encryption, Use of Block Ciphers, Stream Ciphers, Affine Ciphers, Matrices and Linear Maps, Affine Linear Block Ciphers, Vigenere, Hill and Permutation Ciphers, Cryptanalysis of Affine Linear Block Ciphers

#### Unit 3- **Public key cryptosystems :**

Probability and perfect secure, Various One Time Rabin System, ElGamal System, Enciphering matrices, the idea of public key cryptography, design of RSA, some important properties of RSA, Discrete logarithm problem, public key cryptosystem based on Knapsack problem, the concept of zero knowledge transfer.

#### Unit 4- **Primality and factoring:**

Trial Division, Carmichael number, Millor-Rabin Test, p-1 Method, pseudo primes, the rho methods, Fermat factorization and factor basis, the continued fraction method, the quadratic sieve method.

#### Unit 5- **Elliptic curves :**

Basic facts and application of elliptic curve in cryptography, elliptic curve cryptosystem, elliptic curve primality test, elliptic curve factorization. Digital Signatures: RSA Signature, Signature from Public Key Systems, ElGamal Signature.

#### **Books recommended :**

1. A course in number theory and cryptography by N. Koblitz. Springer 2002.
2. An introduction to cryptography by J. A. Buchman. Springer. 2001.
3. Introduction to Cryptography by Hans Delfs and H. Knebl. Springer 2001.
4. Modern cryptography by O. Goldreich. Springer. 1999
5. Modern cryptography: theory and practice by Wenbo Mao. HP. 2004.

## Paper III

# Nonlinear Analysis and Topological Structures

M.M. 100

**Note:** Each unit will be given weight-age of 20 marks. Student will attempt one question from each unit. There will be internal choice in each unit.

**Unit I Calculus in Banach spaces :** Various forms of continuity, geometry in normed spaces and duality mapping, Nemytskii, Hammerstein and Uryshon operators, Gateaux and Frechet derivatives, properties of the derivative, Taylor's theorem, inverse function theorem and implicit function theorem.

**Unit II Monotone operators and its applications :** Basic study of - Monotone operators, surjectivity theorems, constructive solutions of operator equations, subdifferential and monotonicity, generalizations of monotone operators.

**Unit-III Dynamical Systems, Manifolds and Complexes-** The role of topology in Chaos and dynamical systems- *History of Chaos, examples, notions of Chaos*. Identification spaces and compactness. Cantor sets. Application of compact sets in *population dynamics and Fractals*, Manifolds. Triangulations. Classification of surfaces. Euler Characteristics. Topological groups. Group actions and Orbit spaces. Application of manifold in *Robotic coordination and configuration spaces, geometry of manifolds, the topology of the Universe*.

**Unit-IV Homotopy, Winding Numbers and Vector Field-** Homotopy and paths. The winding number. Degrees of maps. The Brouwer fixed point theorem. The Borsuk-Ulam Theorem. Vector fields and the Poincare Index Theorem. Applications in *the fundamental theorem of algebra, Sandwiches, Game theory and Nash equilibria, Vector fields, Path integrals and the winding number, Vector fields on surfaces, Index theory for n-symmetry fields*.

**Unit-V The Topological Degree** Axiomatic Definition of the Brouwer Degree in  $\mathbf{R}^n$ . Application of the Brouwer Degree. Brouwer Theorem, Perron-Frobenius Theorem, Surjective Maps, Hedgehog Theorem. The Leray-Schauder degree. Borsuk's Antipodal Theorem. Compact Linear Operators. Application of topological degree in *Fixed Point Theory*.

### Books recommended :

1. M. C. Joshi and R. K. Bose, Some topics in nonlinear functional analysis, Wiley Eastern Limited, New Delhi 1985.
2. E. Zeidler, Nonlinear functional analysis and its applications I: Fixed Point Theorems, Springer, Heidelberg 1986.
3. K. Deimling, Nonlinear functional analysis and its applications I: Fixed Point Theorems, Springer, Heidelberg 1985.
4. William F. Basener, Topology and its applications, Wiley-InterScience, 1973.
5. R. Akerkar, Nonlinear functional analysis, Narosa Publishing House, New Delhi.
6. C. Robinson, Dynamical Systems, Stability, Symbolic Dynamics and Chaos, CRC Press, 1995.
7. S. Willard, General Topology, Dover, 2004.
8. R. L. Devaney, An Introduction to Chaotic Dynamical Systems, Persues Publishing Co., 1989.

**Ph.D. Course Work**  
**Paper I**  
**2017-18 & Onward**

**Research Methodology, Quantitative techniques and  
Computers**

**M.M. 100**

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