Progressive Education Society's

Modern college of Arts, Science and Commerce,

Ganeshkhind,Pune-16

Autonomous

NEP 2020 (1)

(Under Faculty of Science and Technology)

M.Sc.(Mathematics) : Part-II

Choice Based Credit System Syllabus

To be implemented from Academic Year 2024-2025

M.Sc. (Mathematics) : Part-II

Title of the Course: M.Sc./M.A. (Mathematics)

Preamble :

P.E. Society's Modern College of Arts , Science and Commerce , Ganeshkhind , Pune – 16 has decided to change the syllabi of various faculties from June,2024. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects, Board of studies in Mathematics after a thorough discussion with the teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of M.Sc. Semester - III and Semester- IV (w.e.f. 2024-25) Mathematics course under the Choice Based Credit System (CBCS).

The model curriculum as developed by U. G. C. is used as a guideline for the present syllabus.

Aims and Objectives of the new curriculum :

i) To maintain updated curriculum.

ii) To take care of fast development in the knowledge of mathematics.

iii) To enhance the quality and standards of Mathematics Education.

iv) To provide a broad common frame work, for exchange, mobility and free dialogue across the Indian Mathematical and associated community.

v) To create and aptitude for Mathematics in those students who show a promise for higher studies and creative work in Mathematics.

vi) To create confidence in others, for equipping themselves with that part of Mathematics which is needed for various branches of Sciences or Humanities in which they have aptitude for higher studies and original work.

Syllabus for M.Sc. Mathematics Semester III & IV

Sr. No	Courses		
	Semester-III	**Semester-IV**	**Credit**
	Compulsory courses:		
1	Major Paper-9 : Functional Analysis	Major Paper-13 : Fourier Series and Boundary Value Problems	4
2	Major Paper-10: Field Theory	Major Paper-14 : Differential Geometry	4
3	Major Paper -11: Integral Equations	Major Paper-15 : Probability and Statistics	4
4	Major Paper-12 : Practical in Combinatorics.	---------	2
O=Optional Courses (Any One)			
5	Major Elective5(A) : Advance Complex Analysis	Major Elective7(A) : Number Theory and Coding Theory	2
	Major Elective 5(B) : Mathematics Practical based on Major elective 5(A)	Major Elective 7(B) : Mathematics Practical based on Major Elective 7(A)	2
6	Major Elective6(A) : Mathematical Techniques using Python	Major Elective8(A): Introduction to Data Science	2
	Major Elective 6(B) : Mathematics Practical based on Major elective 6(A)	Major Elective8(B) : Mathematics Practical based on Major elective 8(A)	2
7	RP 4 Credits	RP 6 Credits	

Note : For Optional papers syllabus will be designed / framed by the respective teacher and will get it approved in the BOS meeting when that paper will be conducted in that semester

The educational tour is compulsory.

Syllabus

Semester-3

Paper No. : Major Paper- 9 **Paper Code : MAT63101**

Name of the Paper : Functional Analysis (Theory).

Total No. of Credits : 4 **Total No. of lectures : 60**

UNIT-I: Banach Spaces **[25 Hours]**

1.1 The definition and some examples.

1.2 Continuous linear transformations.

1.3 The Hahn-Banach theorem.

1.4 The natural imbedding of N in N**.

1.5 The open mapping theorem.

1.6 The conjugate of an operator.

UNIT-II: Hilbert Spaces **[25 Hours]**

2.1 The definition and some simple properties.

2.2 Orthogonal complements.

2.3 Orthonormal sets.

2.4 The conjugate space H*.

2.5 The adjoint of an operator.

2.6 Self-adjoint operators.

2.7 Normal and unitary operators.

2.8 Projections.

UNIT-III: Finite-Dimensional Spectral Theory **[10 Hours]**

3.1 Matrices.

3.2 Determinants and the spectrum of an operator.

3.3 The spectral theorem.

3.4 A survey of the situation.

Recommended Book:

G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill.
Chapters: 9, 10, 11.

Reference Books:

1) B. V. Limaye, Functional Analysis, Wiley Eastern Ltd.

2) George Bachman, Lawrence Narici, Functional Analysis, Dover Publications.

3) E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley, 1989.

Paper No. : Major Paper- 10 **Paper Code : MAT63102**

Name of the Paper : Field Theory (Theory).

Total No. of Credits : 4 **Total No. of lectures : 60**

UNIT 1: Algebraic Extension of fields: **[12 Hours]**

1.1 Irreducible polynomials and Eisenstein criterion, adjunction of roots,

1.2 Algebraic extensions, algebraically closed fields.

UNIT 2: Normal and Separable extensions: **[12 Hours]**

2.1 Splitting fields,

2.2 Normal extensions, multiple roots, finite fields, separable extensions.

UNIT 3: Galois Theory: **[20 Hours]**

3.1 Automorphism groups and fixed fields,

3.2 Fundamental theorem of Galois theory,

3.3 Fundamental theorem of algebra.

UNIT 4: Applications of Galois theory to classical problems: **[16 Hours]**

4.1 Roots of unity and cyclotomic polynomials, cyclic extensions,

4.2 polynomials solvable by radicals, symmetric functions,

4.3 Ruler and compass constructions.

Recommended Book:

P. B. Bhattacharyya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra , Cambridge University Press, Second Edition. Chapter no: 15, 16, 17 and 18.

Reference Books:

1. D. Dummit and R.M.Foote, Abstract Algebra, 2nd Edition, Wiley Eastern Ltd.

2. T. A. Hungerford, Algebra, Graduate Texts in Mathematics, Vol. 73, SpringerVerlag, 1980 (Indian Reprint 2004).

3. O. Zariski and P. Sammuel, Commutative Algebra, Vol. 1, Van Nostrand. 4. I. S. Luthar, I. B. S. Passi, Algebra, Vol.

4, Field Theory, Narosa Publishing House

5. M. Artin, Algebra, Prentice Hall India, Second Edition.

Paper No. : Major Paper- 11 **Paper Code : MAT63103**

Name of the Paper : Integral Equations (Theory).

Total No. of Credits : 4 **Total No. of lectures : 60**

Unit-I Introductory Concepts **[12Hours]**

1.1 Definitions

1.2 Classification of Linear Integral Equations

1.3 Solution of an Integral Equation

1.4 Converting Volterra Equation to ODE

1.5 Converting IVP to Volterra Equation

1.6 Converting BVP to Fredholm Equation

Unit-II Fredholm Integral Equations **[14 Hours]**

1.7 Introduction

1.8 The Decomposition Method

1.9 The Direct Computation Method

1.10 The Successive Approximation Method

1.11 The Method of Successive Substitutions

1.12 Comparison between Alternative Methods

1.13 Homogeneous Fredholm Equations

Unit-III Volterra Integral Equations **[14 Hours]**

1.14 Introduction

1.15 The Decomposition Method

1.16 The Series Solution Method

1.17 Converting Volterra Equation to IVP

1.18 The Successive Approximation Method

1.19 The Method of Successive Substitutions

1.20 Comparison between Alternative Methods

1.21 Volterra Equation of the First Kind

Unit-IV Integro-Differential Equations **[10 Hours]**

1.22 Introduction

1.23 Fredholm Integro-Differential Equations

1.24 Volterra Integro-Differential Equations

Unit-V Singular Integral Equations **[10 Hours]**

1.25 Definitions

1.26 Abel‟s Problem

1.27 The Weakly-Singular Volterra Equations

Recommond Book:

1. Abul-Majid Wazwaz, A First Course In Integral Equations, World Scientific Publications, 1997. Chapter-1 -5.

Reference Books:

Kanwal Ram P., Linear Integral Equations, Birkhauser publication 1997. 1. Abdul J. Jerri, Introduction to Integral Equations With Applications, Wiley-Interscience; 2 edition (September 3, 1999)

Paper No. : Major Paper- 12 Paper Code : MAT63104

Name of the Paper : Practical Course in Combinatorics (Practical).

Total No. of Credits : 2 Total No. of Practicals : 15

UNIT-I: Basic Counting Principles [10 Hours]

4.1 Two Basic Counting Principles.

4.2 Simple Arrangements and Selections.

4.3 Arrangements and Selections with Repetitions.

4.4 Binomial Identities.

UNIT-II: Generating Functions [10 Hours]

5.1 Generating Functions Models.

5.2 Calculating Coefficients of Generating Functions.

5.3 Exponential Generating Functions.

UNIT-III: Recurrence Relations [10 Hours]

6.1 Recurrence Relations Models, Solutions of Linear Recurrence Relations.

6.2 Counting with Venn Diagrams.

6.3 Inclusion-Exclusion Formula.

List of Practicals

Practical 1: Problems on Two Basic Counting Principles.

Practical 2: Problems on Simple Arrangements and Selections.

Practical 3: Problems on Arrangements and Selections with Repetitions.

Practical 4: Problems on Binomial Identities.

Practical 5: Problems on constructing Generating Functions.

Practical 6: Problems on calculating coefficients of Generating Functions.

Practical 7: Problems on Exponential Generating Functions.

Practical 8: Recurrence Relations.

Practical 9: Counting with Venn Diagrams.

Practical 10: Inclusion-Exclusion Principle.

Practical 11. Miscellaneous.

Practical 12. Miscellaneous.

Practical 13. Miscellaneous.

Practical 14. Miscellaneous.

Practical 15. Miscellaneous.

Paper No. : Major Elective Paper - 5(A) Paper Code : MAT63105

Name of the Paper : Advance Complex Analysis (Theory).

Total No. of Credits : 2 Total No. of Lectures : 30

Unit-I Cauchy's Theorem and it Applications: [06 Hours]

1.1 Revision

1.2 Further Applications : Sequences of holomorphic functions, Holomorphic functions defined in terms of integrals, Schwarz reflection principle, Runge's approximation theorem.

Unit-II Conformal Mappings: [10 Hours]

2.1 Conformal equivalences and examples:The disc and upperhalf plane,further examples, The Dirichlet in a strip

2.2 The Schwarz lemma, automorphism of the disc and upper half plane, Automorphism of the disc, Automorphism of the upper half plane

Unit-III The Riemann mapping : [10 Hours]

3.1 The Riemann mapping theorem, Necessary conditions and statement of the theorem, Montel's theorem,proof of the Riemann mapping theorem

3.2 Conformal mappings onto polygons: Some examples, The Schwarz- Christoffle integral, boundary behaviour, The mapping formula

Unit-IV An introduction to elliptic functions: [04 Hours]

4.1 Elliptic functions: Liouville's theorem, The Weierstrass function

Recommended Book

1. Stein and Shakarchi, Complex Analysis, Princeton University Press, 2006 Chapter 2 : Sections 1 to 4 Revision, Section 5, Chapter 8: Sections 1, 2, 3, 4 Chpater 9: Section 1

Reference Books :

1. J. B. Conway , Functions of one complex variable, 2nd edition, GTM 11,Springer Verlag, 1973

2. A. R Shastri, Basic complex analysis of one variable, McMilan Publishers,India, Ltd. 2011

Paper No. : Major Elective Paper - 5(B) Paper Code : MAT63106

Name of the Paper : Practical course based on MAT63105 (Practical).

Total No. of Credits : 2 Total No. of Practicals : 15

Paper No. : Major Elective Paper - 6(A) Paper Code : MAT63107

Name of the Paper : Programming with Python (Theory).

Total No. of Credits : 2 Total No. of Lectures : 30

UNIT-I: Introduction to Python, Python Objects [2 Hours]

1.1 Features of Python: Easy; Type and Run ; Syntax; Mixing; Dynamic Typing; Built in Object Types; Numerous Libraries and Tools.

1.2 Chronology and Uses: Chronology; Uses.

1.3 Installation of Anaconda.

1.4 Basic Data Types Revisited: Fractions.

1.5 Strings.

1.6 Lists and Tuples: List; Tuples; Features of Tuples.

UNIT-II: Conditional Statements [2 Hours]

2.1 if, if-else, and if-elif-else constructs.

2.2 The if-elif-else Ladder.

2.3 Logical Operators.

2.4 The Ternary Operator

2.5 The get Construct.

2.6 Examples.

UNIT-III: Looping **[2 Hours]**

3.1 While.

3.2 Patterns.

3.3 Nesting and Applications of Loops in Lists.

UNIT-IV: Functions **[2 Hours]**

4.1 Features of a functions: Modular Programming; Reusability of Code; Manageability.

4.2 Basic Terminology: Name of Functions; Arguments; Return Value.

4.3 Definition and Invocation: Working.

4.4 Type of Functions: Advantage of Arguments.

4.5 Implementing Search.

4.6 Scope.

4.7 Recursion: Rabbit Problem; Disadvantages of Using Recursion.

UNIT-V: Iterations, Generators, and Comprehensions **[2 Hours]**

5.1 The Power of "For".

5.2 Iterators.

5.3 Defining an Iterable Object.

5.4 Generators.

5.5 Comprehensions.

UNIT-VI: File Handling **[3 Hours]**

6.1 The File Handling Mechanism.

6.2 The Open Function and File Access Modes.

6.3 Python Functions for File Handling: The Essential Ones; The OS Methods; Miscellaneous Functions and File Attributes.

6.4 Command Line Arguments.

6.5 Implementation and Illustrations.

UNIT- VII: Strings **[3 Hours]**

7.1 The Use of "For" and "While".

7.2 String Operators: The Concatenation Operator (+); The Replication Operator; The Membership Operator.

7.3 Functions for String Handling: len(); Capitalize(); find(); count; Endswith(); Encode; Decode;Miscellaneous Functions.

UNIT-VIII: Introduction to Object Oriented Paradigm [3 Hours]

8.1 Creating New Types.

8.2 Attributes and Functions: Attributes; Functions.

8.3 Elements of Object- Oriented Programming: Class; Object; Encapsulation; Data Hiding; Inheritance; Polymorphism; Reusability.

UNIT-IX: Classes and Objects [3 Hours]

9.1 Defining a Class.

9.2 Creating an Object.

9.3 Scope of Data Members.

9.4 Nesting.

9.5 Constructor.

9.6 Constructor Overloading.

9.7 Destructors.

UNIT-X: Inheritance [4 Hours]

10.1 Introduction to Inheritance and Composition : Inheritance and Methods, Composition.

10.2 Inheritance: Importance and Types: Need of Inheritance; Types of Inheritance.

10.3 Methods: Bound Methods; Unbound Method; Methods are Callable Objects; The Importance and Usage of Super; Calling the Base Class Function Using Super.

10.4 Search in Inheritance Tree.

10.5 Class Interface and Abstract Classes.

UNIT-XI: Operator Overloading [2 Hours]

11.1 _init_Revisited: Overloading _init_(Sort of).

11.2 Methods for Overloading Binary Operators.

11.3 Overloading the += Operator

11.4 Overloading the > and < Operators.

11.5 Overloading the _boolEan_ Operators: Precedence of _bool_over _len_.

11.6 Destructors

UNIT-XII: Exception Handling **[2 Hours]**

12.1 Importance and Mechanism: An exaple of Try/Catch; Manually Raising Exception.

12.2 Built In Exceptions in Python:

12.3 The Process: Exception Handling: Try/Except; Raising Exceptions.

12.4 Crafting User Defined Exceptions.

12.5 An Example of Exception Handling.

Recommended book:

H. Bhasin: Python Basics, MERCURY LEARNING AND INFORMATION Dulles, Virginia Boston, Massachusetts New Delhi Chapter 1: 1.2, 1.4, 1.5. Chapter 2: 2.2 to 2.4. Chapter 3: 3.2 to 3.7;Chapter 4: 4.2 to 4.4 Chapter 5: 5.2, to 5.8. Chapter 6: 6.2 to 6.6. Chapter 7: 7.1, to 7.6; Chapter 8: 8.1, to 8.4. Chapter 9: 9.1, 9.2, 9.3, 9.4. Chapter 10: 10.1, to 10.8.; Chapter 11: 11.1to 11.5. Chapter 12: 12.2, to 12.8.; Chapter 13: 13.2, to 13.6.

Reference Books:

1. Beginning-Python, Second Edition by Magnus Lie Hetland

2. The Complete Reference Python by Martin C. Brown

3. Head First Python by Patrick Barry

4. Learning Python, O‟Reilly by Mark Lutz

5. Python in a Nutshell, O‟Reilly by Alex Martelli

Paper No. : Major Elective Paper - 6**(B)** **Paper Code : MAT63108**

Name of the Paper : Practical course based on MAT63107 (Practical).

Total No. of Credits : 2 **Total No. of Practicals : 15**

Paper : Research Project **Paper Code : MAT63609**

Name of the Paper : Research Project.

Total No. of Credits : 4

Research Project

Semester – IV

Paper No. : Major Paper- 13 **Paper Code : MAT64101**

Name of the Paper : Fourier Series and Boundary Value Problems.

(Theory)

Total No. of Credits : 4 **Total No. of lectures : 60**

Unit-I Fourier Series **[10 Hours]**

1.1 Piecewise Continuous Functions ,Fourier Cosine Series, Examples,

1.2 Fourier Sine Series, Examples,

1.3 Fourier Series, Examples,

1.4 Adaptations to other Intervals

Unit-II Convergence Of Fourier Series **[10 Hours]**

2.1 One-Sided Derivatives, Property of Fourier Coefficients

2.2 Two Lemmas, Fourier Theorem , Discussion of the theorem and its Corollary, Convergence on other intervals, Lemma

2.3 Absolute and uniform convergence of Fourier series, Differentiation of Fourier series, Integration of Fourier series

Unit-III The Fourier Method **[8 Hours]**

3.1 Linear Operators, Principle of Superposition

3.2 A Temperature Problem, A Vibrating String Problem

Unit-IV Boundary Value Problems **[12 Hours]**

4.1 A Slab with Faces at Prescribed Temperatures, Related Problems, A Slab with Internally Generated Heat, Steady Temperatures in a Rectangular Plate

4.2 Cylindrical Coordinates, String with Prescribed Initial Conditions, Resonance, Elastic Bar

4.3 Double Fourier Series, Periodic Boundary Conditions

Unit -V Orthonormal Sets **[10 Hours]**

5.1 Inner Products and Orthonormal Sets, Examples

5.2 Generalized Fourier series, Examples

5.3 Best approximation in the Mean, Bessel‟s Inequality and Parseval‟s Equation

5.4 Application to Fourier series

Unit-VI Sturm-Liouvilles Problems and Applications **[10 Hours]**

6.1 Regular Sturm-Liouville Problems, Modifications, Orthogonality of Eigen functions, Real-Valued Eigen functions and Non negative Eigen Values, Methods of solution,

6.2 Examples of Eigen functions Expansions, A Temperature Problem in Rectangular Coordinates , Another Problem, Other Coordinates

6.3 Modification of the Method, Another Modification

Recommended Book:

J.W.Brown & R.V.Churchill: Fourier Series and Boundary Value Problems. VIIth Edition, McGraw Hill Education(India) Private Limited,New Delhi.Chapter-1 (Art. 1 to 8) ,Chapter-2 (Art. 9 to 18), Chapter-4 (Art. 29 to 32), Chapter-5 (Art. 34 to 43), Chapter-7 (Art. 52 to 58), Chapter-8 (Art. 59 to 69)

Reference Book:

Murray Spiegel, Fourier Analysis with Applications to Boundary Value Problems, Schaum‟s Outline Series, McGraw Hill.

Paper No. : Major Paper- 14 **Paper Code : MAT64102**

Name of the Paper : Differential Geometry (Theory).

Total No. of Credits : 4 **Total No. of lectures : 60**

Unit-I **[15 Hours]**

1.1 Graphs and Level Sets,

1.2 Vector Fields,

1.3 The Tangent Space,

1.4 Surfaces.

Unit-II **[15 Hours]**

2.1 Vector Fields on Surfaces;

2.2 Orientation,

2.3 The Gauss Map,

2.4 Geodesics,

2.5 Parallel Transport.

Unit-III **[15 Hours]**

3.1 The Weingarten Map,

3.2 Curvature of Plane Curves,

3.3 Arc Length and Line Integrals.

Unit-IV **[15 Hours]**

4.1 Curvature of Surfaces.

Recommended Book:

J.A. Thorpe, Elementary Topics in Differential Geometry, First Indian Reprint, Springer Publication. Chapters: 1 to 12.

Reference Books:

1) Erwin Kryszig, Differential Geometry, Dover Publications Inc.
2) Christian Bar, Elementary Differential Geometry, Cambridge University Press.
3) Andrew Pressley, Elementary Differential Geometry, Springer.

4) T.J. Willmore, An Introduction to Differential Geometry, Dover Publications Inc.

Paper No. : Major Paper- 15 **Paper Code : MAT64103**

Name of the Paper : Probability and Statistics (Theory).

Total No. of Credits : 4 **Total No. of lectures : 60**

Unit I: Introduction to Probability **[5 lectures]**

1.1 Sample space, events, probability of an event, additive rules, conditional probability,

1.2 Multiplicative rule, Bayes' rule.

Unit II: Random Variable **[16 lectures]**

2.1 Concept of a random variable, discrete probability distribution, continuous

probabilitydistribution, joint probability distribution,

2.2 Independent random variables, Chebyshev's theorem, Mean of a random variables, Variance and Covariance, Mean and Covariance of linear combinations of random variables, Functions of random variables, transformations of variables,

2.3 Moments and Moment Generating Functions, definition of Expectation, theorems on Expectation and its related problems, Variance in terms of Expectation and related problems,

2.4 Covariance in terms of Expectation and related problems, Variance of a

Linear Combination.

Unit III: Some Discrete Probability Distributions **[12 lectures]**

3.1 Binomial and Multinomial distributions, Hypergeometric distribution, Negative Binomial distribution, Geometric distribution,

3.2 Poisson distribution and Poisson process.

Unit IV: Some Continuous Probability Distributions **[13 lectures]**

4.1 Continuous Uniform distribution, Normal distribution, area under the normal curve, applications of the Normal distribution, normal approximation to the binomial distribution,

4.2 Gamma distribution, Exponential distribution, Chi-squared distribution.

Unit V: Linear Regression and Correlation **[14 lectures]**

5.1 Simple Linear Regression, lines of Regression, Least Squares and Fitted Model,

5.2 properties of Least Squares Estimators, Regression Coefficients, choice of Regression model, data plot and transformations,

5.3 Karl Pearson"s Coefficient of Correlation, Properties and Problems, Spearmen"s Rank Correlation Coefficient, Method of Concurrent Deviations.

Recommended Book:

 Probability and Statistics for Engineers and Scientists, by R. Walpole, R.H. Myers,

S.L. Myers,and K. Ye (Seventh Edition, Pearson India). Chapters: 2, 3, 4, 5, 6.1 – 6.8, 7.3, 11.

Reference Books:

 Introduction to Probability and Statistics for Engineers and Scientists, by Sheldon

M. Ross(Fourth Edition).

 A first course in Probability, by Sheldon M. Ross (Nineth Edition).

 Mathematical Statistics, by Parimal Mukhopadhyay.

 Statistics for the Life Sciences, by M. Samules, J. Witmer and A. Schaffner (Fifth

Edition,Pearson India)

 Probability and Statistics for Engineers, by Richard Gupta, C B Gupta.

Paper No. : Major Elective Paper - 7(A) Paper Code : MAT64104

Name of the Paper : Number Theory (Theory).

Total No. of Credits : 2 Total No. of Lectures : 30

Unit I: Unique Factorization **[10 hours]**

1.1 : Unique Factorization in Z, Unique Factorization in k[x].

1.2 : Unique Factorization in a Principal Ideal Domain.

1.3 : The Rings Z[i] and Z[ω].

Unit II: Congruence **[10 hours]**

2.1: Congruence in Z., The congruence $ax \equiv b(m)$.

2.2: The Chinese Remainder Theorem.

Unit III: Quadratic Reciprocity **[10 hours]**

3.1: Quadratic Residues.

3.2: Quadratic Reciprocity

Unit IV: Some Functions of Number Theory **[10 hours]**

4.1: The Greatest Integer Function.

4..2: Arithmetic Functions.

4.3: The Mobius Inversion Formula.

Unit V: Algebraic Numbers **[08 hours]**

5.1: Algebraic Numbers.

5.2: Algebraic Number Fields. Algebraic Integers.

5.3: Quadratic Fields.,

Recommended Books:

1. Kenneth Ireland, Michael Rosen: A Classical Introduction to Modern Number Theory, Springer, 4th Indian Reprint, 2013. Unit I: Chapter 1: Arts 1 to 4., Unit II: Chapter 3: Arts 1 to 4.

2. Ivan Niven; Herbert Zuckerman; Hugh Montgomery: An Introduction to Theory of Numbers, John Wiley and Sons, 5th Edition. Unit III: Chapter 3: Arts 3.1 and 3.2, Unit IV: Chapter 4: Arts 4.1 to 4.3, Unit V: Chapter 9: Arts 9.1 to 9.6

Reference Books:

(1) S.G.Telang: Number Theory, Tata McGraw Hill.

(2) M.B.Nathanson: Methods in Number Theory, GTM , Springer 3rd Indian Reprint, 2009.

Paper No. : Major Elective Paper - 7(B) Paper Code : MAT64105

Name of the Paper : Practical based on Number Theory and Coding Theory (Practical).

Total No. of Credits : 2 Total No. of Practical : 15

List of Practical

Practical 1 : Practical based on Unit 1.

Practical 2 : Practical based on Unit 1.

Practical 3 : Practical based on Unit 1.

Practical 4 : Practical based on Unit 2.

Practical 5 : Practical based on Unit 2.

Practical 6 : Practical based on Unit 2.

Practical 7 : Practical based on Unit 3.

Practical 8 : Practical based on Unit 3.

Practical 9 : Practical based on Unit 3.

Practical 10 : Practical based on Unit 4.

Practical 11 : Practical based on Unit 4.

Practical 12 : Practical based on Unit 4.

Practical 13 : Practical based on Unit 5.

Practical 14 : Practical based on Unit 5.

Practical 15 : Practical based on Unit 5.

Paper No. : Major Elective Paper - 8(A) Paper Code : MAT64106

Name of the Paper : Introduction to Data Science (Theory).

Total No. of Credits : 2 Total No. of Lectures : 30

1. Data science in a big data world **[08 Hours]**

1.1. Benefits and uses of data science and big data

1.2. Facets of data

1.3. The data science process

1.4. The big data ecosystem and data science

2. The data science process **[10 Hours]**

2.1. Overview of the data science process

2.2. Retrieving data

2.3. Cleansing, integrating, and transforming data

2.4. Exploratory data analysis

3. Machine learning **[08 Hours]**

3.1. What is machine learning

3.2. The modelling process

3.3. Types of machine learning

3.4. Semi-supervised learning

4. Handling large data **[14 Hours]**

4.1. General techniques for handling large volumes of data

4.2. General programming tips for dealing with large data sets

4.3. Case study Predicting malicious URLs

5. First steps in big data **[10 Hours]**

5.1. Distributing data storage and processing with frameworks

5.2. Case study: Assessing risk

6. Text mining and text analytics and Data visualization **[10 Hours]**

6.1. Text mining techniques

6.2. Data visualization options

Recommended Book:

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016

Reference Books:

1. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

2. Introduction to Machine Learning, Ethem Alpaydin, Third Edition 2018 PHI Learning Private Limited

Paper No. : Major Elective Paper - 8(B) **Paper Code : MAT64107**

Name of the Paper : Practical based on Introduction to Data Science (Practical).

Total No. of Credits : 2 **Total No. of Practical : 15**

List of Practical

Practical 1 : Practical based on Unit 1.

Practical 2 : Practical based on Unit 1.

Practical 3 : Practical based on Unit 1.

Practical 4 : Practical based on Unit 2.

Practical 5 : Practical based on Unit 2.

Practical 6 : Practical based on Unit 2.

Practical 7 : Practical based on Unit 3.

Practical 8 : Practical based on Unit 3.

Practical 9 : Practical based on Unit 3.

Practical 10 : Practical based on Unit 4.

Practical 11 : Practical based on Unit 4.

Practical 12 : Practical based on Unit 4.

Practical 13 : Practical based on Unit 5.

Practical 14 : Practical based on Unit 6.

Practical 15 : Practical based on Unit 5 and 6.

Paper : Research Project **Paper Code : MAT64608**

Name of the Paper : Research Project.

Total No. of Credits : 6

Research Project