Rayat Shikshan Sanstha's

R. B. Narayanrao Borawake College, Shrirampur (Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Department of Mathematics

FYUG (Mathematics) Syllabus as per NEP-2020

Implemented

From

Academic Year: 2023-24

F.Y.B.Sc. (Mathematics) Core Subjects (Semester-I)

Year	Semester	Course Type	Course Code	Course Title	Theory/ Practical	Credits	No. of Lectures/ Practical to be conducted	Page No.
1st	I	DSC (Major)	MT-MJ-111T	Algebra	Theory	2	30L	**4-5**
			MT-MJ-112T	Calculus-I	Theory	2	30L	**6-7**
			MT-MJ-113P	Practical Based on Algebra and Calculus-I	Practical	2	12P	**8-9**
		VSC	MT-VSC-114T	Foundations of Mathematics	Theory	2	30L	**10-11**
		SEC	MT-SEC-115P	Introduction to Python Programming	Theory	2	30L	**12-14**
		IKS	MT-IKS-116T	Vedic Mathematics	Theory	2	30L	**15-16**

F.Y.B.Sc. (Mathematics) Core Subjects (Semester-II)

Year	Semester	Course Type	Course Code	Course Title	Theory/ Practical	Credits	No. of Lectures/ Practical to be conducted	Page No.
1st	II	DSC (Major)	MT-MJ-121T	Analytical Geometry	Theory	2	30L	**18-19**
			MT-MJ-122T	Calculus-II	Theory	2	30L	**20-21**
			MT-MJ-123P	Practical Based on Analytical Geometry and Calculus-II	Practical	2	12P	**22-23**
		VSC	MT-VSC-124P	Latex for Scientific Typing	Practical	2	30L	**24-25**
		SEC	MT-SEC-125P	Basics of Machine Learning	Practical	2	30L	**26-27**

Syllabus for F.Y.B.Sc. (Mathematics)

Semester I

DISCIPLINE SPECIFIC CORE COURSE (MT-MJ-111T): Algebra

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-MJ-111T- Algebra	2	2	--

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To use mathematical induction to prove various results of integers.
- To learn congruence and its properties.
- Identify the relationship between the degree of polynomial and the roots, constant coefficients of the polynomial.
- To solve the problems of system of linear equations by various methods.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Use the Mathematical induction and find the LCM and GCD of two integers

CO-2: Solve various problems on properties of integers and use the basic concepts of divisibility, congruence and their applications in basic algebra.

CO-3: Solve problems involving polynomial equations, finding roots and factors of the polynomial.

CO-4: Solve the problems on system of linear equations by various methods and use Cayley Hamilton theorem.

SYLLABUS of MT-MJ-111T: Algebra

Unit I: Divisibility Theory in the Integers **[06 Hours]**

1.1 Mathematical Induction: Well-Ordering Principle.

1.2 The Division Algorithm, The Greatest Common Divisor, Euclid's Lemma, The Least Common Multiple, The Euclidean Algorithm (without proof).

Unit II: Primes and the theory of Congruence **[06 Hours]**

2.1 The Fundamental Theorem of Arithmetic: Prime Numbers, Euclid's Lemma.

2.2 The theory of Congruence: Basic Properties of congruence.

2.3 Fermat's Theorem

Unit III: Polynomials **[06 Hours]**

3.1 Definition of polynomial, Degree of polynomial, Algebra of polynomials, Division algorithm (without proof). G.C. D of two polynomials (without proof).
3.2 Remainder Theorem, Factor Theorem.
3.3 Relation between the roots and the coefficients of a polynomial, Examples.

Unit IV: Matrices and System of linear equations [12Hours]

1.1 Matrices, Echelon and Reduced echelon form of a matrix, Reduction of matrix to its echelon form, Definition of rank of a matrix by using echelon form.
1.2 System of linear equations, Matrix form of system of linear equations, Homogeneous and non-homogeneous system of linear equations, Gauss Elimination and Gauss Jordan Method.
1.3 Consistency of a system of linear equations, condition of consistency (without proof)
1.4 Eigen values, Eigen vectors, characteristic equation of a matrix of order up to 3×3.
1.5 Statement of Cayley Hamilton theorem and its use to find the inverse of a matrix.

ESSENTIAL/RECOMMENDED READINGS:

1. Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition.
2. H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed Wiley, (1994).

DISCIPLINE SPECIFIC CORE COURSE (MT-MJ-112T): Calculus-I

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-MJ-112T– Calculus-I	2	2	--

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To learn algebraic and order properties of real numbers and the crucial Completeness properties.
- To make students accustomed to the notion of $\in$ and to understand the sequences and their limits.
- To understand the fundamental properties of continuous functions.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Identify algebraic and order properties of real numbers.

CO-2: Identify and apply the function properties of real number system such as the completeness property.

CO-3: Verify the values of limit of a function at a point using the definition of a limit.

CO-4: Student will be able to understand differentiation and fundamental theorem in differentiation and various rules.

SYLLABUS of MT-MJ-112T: Calculus-I

Unit I: The Real Numbers **[08 Hours]**

1.1 The Algebraic and Order Properties of $\mathbb{R}$: Algebraic properties of $\mathbb{R}$, Order properties of $\mathbb{R}$, Well-Ordering Property of $\mathbb{N}$. Bernoulli's inequality.

1.2 Absolute Value and the Real Line: Absolute value function and its properties, triangle inequality and its Consequences.

1.3 The Completeness Property of $\mathbb{R}$: Definitions of Upper bound, Lower bound, supremum, infimum of subsets of $\mathbb{R}$, completeness property of $\mathbb{R}$.

1.4 Applications of the Supremum Property: Archimedean property, The density theorem (without proof).

Unit II: Limit and Continuity **[12 Hours]**

2.1 Functions: Functions, domain and range.

2.2 Sequences and Their Limits: Definition and examples of sequences of real numbers, Definition of limit of sequence and Examples on convergence of sequence.

2.3 $\epsilon - \delta$ definition of limit of a function, Basic properties of limits. sequential approach of limit of function

2.4 Continuity of function at a point, Types of discontinuity.

2.5 Continuous functions on intervals.

2.6 Properties of continuous functions on closed and bounded interval.

(i) Boundedness (ii) Attains its bounds.

(iii) Intermediate value theorem (iv) Sequential criterion for continuity.

Unit III: Differentiation **[10 Hours]**

3.1 Definition of derivative of a real valued function at a point, notion of differentiability, geometric interpretation of a derivative of a real valued function at a point.

3.2 Differentiability of a function over an interval.

3.3 Statement of rules of differentiability, chain rule of finding derivative of composite of differentiable functions (without proof), derivative of an inverse Function.

ESSENTIAL/RECOMMENDED READINGS:

1. Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert, Third Edition, John Wiley and Sons, 2002

   Unit 1: Chapter 2: Sec 2.1, Sec. 2.2(2.2.1-2.2.6), 2.3(2.3.1, 2.3.2, 2.3.5, 2.3.6), 2.4(2.4.3, 2.4.8).

   Unit 2: Chapter 3: Sec 3(3.1.1-3.1.3, 3.1.6, 3.1.7)

   Unit 3: Chapter 6: Sec. 6.1(6.1.1 to 6.1.8)

2. Mathematical Analysis by S C Malik and Savita Arora, Fifth Edition, New Age International (P) Limited, Publishers.

   Unit 2: Chapter 5: Sec 1(1.1, 1.2,1.3), Sec. 2(2.1, 2.2, 2.3, 2.4), Sec. 3

3. Differential Calculus by Shanti Narayan, Tenth Revised Edition.

DISCIPLINE SPECIFIC CORE COURSE (MT-MJ-113P): Practical Based on Algebra and Calculus-I

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-MJ-113P- Practical Based on Algebra and Calculus-I	2	--	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To acquire the knowledge necessary to apply basic concepts of algebra and calculus, other contemporary mathematical tools.
- To improve student's analytical, cognitive and computational skills.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Improve the ability of students to solve the problems.
CO-2: Solve the most difficulties possible strengthens theoretical notions.
CO-3: Clarify their doubts because of one-to-one interaction with the teacher.
CO-4: Gain the ability to use mathematical ideas to solve practical and everyday issues.
CO-5: Develop an interdisciplinary approach.

SYLLABUS OF MT-MJ-113P: Practical Based on Algebra and Calculus-I

(Practicals based on the applications of articles in MT-MJ- 111T& MT-MJ- 112T)
In Semester-I, we should conduct 3 written practical and 3 practicals on maxima software for each paper MT-MJ- 111T& MT-MJ- 112T.

List of Practical

Practical 1: Problems on Unit 1 and Unit 2(Written) from MT-MJ-111T
Practical 2: Problems on Unit 3 (Written) from MT-MJ-111T.
Practical 3: Problems on Unit 4(Written) from MT-MJ-111T.
Practical 4: Introduction to maxima software from MT-MJ-111T.
Practical 5: Problems on unit 1 and unit 2 from MT-MJ-111T using maxima software.
Practical 6: Problems on Unit 3 and Unit 4 from MT-MJ-111T using maxima software.
Practical 7: Problems on Unit 1 and Unit 2(Written) from MT-MJ-112T.
Practical 8: Problems on Unit 3 (Written) from MT-MJ-112T.

Practical 9: Problems on Unit 4(Written) from MT-MJ-112T.
Practical 10: Introduction to maxima software for MT-MJ-112T.
Practical 11: Problems on unit 1 and unit 2 from MT-MJ-112T using maxima software.
Practical 12: Problems on Unit 3 and Unit 4 from MT-MJ-112T using maxima software.

Note:

1. The soft copy of practicals on maxima software will be prepared and provided by the Board of Studies.
2. Practicals on maxima software can be performed on computer and android mobiles.
3. Android mobiles are allowed for practical examination on Maxima software.

VOCATIONAL SKILL COURSE (MT-VSC-114T): Foundations of Mathematics

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-VSC-114T – Foundations of Mathematics	2	2	--

LEARNING OBJECTIVES

- Approach proof construction problems in a strategic way. Apply and identify applications of derived rules.
- Determine whether a relation is a function and identify the types of relations, domain and range of a function.
- Determine the number of possible combinations for a given situation using the fundamental counting principle.
- Solve various problems on properties of integers and complex numbers.

COURSE OUTCOMES

After completion of this course student will be able to:

CO-1: Prove mathematical statements by deductive reasoning or by exhaustion or disprove them using a counter example

CO-2: Solve problems on equivalence relations, functions, inverse functions, Composition of functions.

CO-3: Determine the number of possible combinations for a given situation using the fundamental counting principle.

CO-4: Solve problems on basic properties of complex numbers, different forms of Complex numbers, algebraic equations and regions in the complex plane.

SYLLABUS OF MT-VSC-114T: Foundations of Mathematics

Unit I: Logic and Proofs **[08 Hours]**

1.1 Propositional logic.
1.2 Propositional equivalences.
1.3 Predicates and quantifiers.
1.4 Nested quantifiers.
1.5 Rules of inference.
1.6 Introduction to proofs.

Unit II: Sets Relations and Functions [08 Hours]

2.1 Sets, Relations, Equivalence relations, Equivalence classes and partitions of a set.

2.2 Functions, Basic terminology, Types of Functions, Inverse of a Function, Composition of Functions (Excluding theorems only examples).

Unit III: Basics of Counting [06 Hours]

3.1 The basics of counting.

3.2 Permutation and combinations,

3.3 Inclusion-Exclusion

Unit IV: Complex Numbers [08 Hours]

4.1 Sums and Products, Basic Algebraic Properties, Moduli, Complex Conjugates, Exponential form, Products and Quotients, De-Moivre's theorem.

4.2 Roots of Complex Numbers: The n^{th} roots of unity.

4.3 Regions in Complex Plane.

ESSENTIAL/RECOMMENDEDREADINGS:

1) Bernard Kolman, Robert C. Busby, Sharon Cutler Ross and Nadeem-ur-Rehman: Discrete
2) Mathematical Structures, Fifth Edition, Pearson Education, Inc., 2004.
3) Kenneth H. Rosen, Discrete Mathematics and its Applications, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd., 2003.
4) A Foundation Course in Mathematics, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House.
5) Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, Mc-Graw Hill, Seventh Edition.

SKILL ENHANCEMENT COURSE (MT-SEC-115P): Introduction to Python Programming

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-SEC-115P- Introduction to Python Programming	2	--	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To understand why Python is a useful scripting language for developers.
- To learn how to use lists, tuples and dictionaries in Python programs.
- To learn and understand python looping, control statements and string manipulations.
- To acquire programming skills in core Python.

COURSE OUTCOMES:

After completion of this course student will be able to:

CO-1: Explain basic principles of Python programming language.
CO-2: Understand the importance of Python tools for Mathematics and Science
CO-3: Learn how to use lists, tuples and dictionaries in Python programmers.
CO-4: Learn Conditional Statements Looping statement in python.

SYLLABUS OF MT-SEC-115P: Introduction to Python Programming

Unit I: Introduction to Python

1.1 Installation of Python.
1.2 Values and types: int, float and string
1.3 The Print Function: Print basics
1.4 Variables: assignment statements, printing variable values, types of variables.
1.5 Mathematical Operators, operands and precedence: +, -, /, *, **, % PEMDAS (Rules of precedence).
1.6 String operations: + : Concatenation, * : Repetition
1.7 Boolean operator:
  1.7.1 Comparison operators: ==, !=, >, =, <=
  1.7.2 Logical operators: and, or, not
1.8 Mathematical functions from math, cmath modules, random module.
1.9 Keyboard input: input() statement

1.10 Calculus: Differentiation, Integration, Limit and Series

Unit II: String, list, tuple

2.1 Strings:

- **2.1.1** Length (Len function)
- **2.1.2** String traversal: Using while statement, Using for statement
- **2.1.3** String slice
- **2.1.4** Comparison operators (>,<,==)

2.2 Lists:

- **2.2.1** List operations
- **2.2.2** Use of range function
- **2.2.3** Accessing list elements
- **2.2.4** List membership and for loop
- **2.2.5** List operations
- **2.2.6** Updating list: addition, removal or updating of elements of a list

2.3 Tuples:

- **2.3.1** Defining a tuple,
- **2.3.2** Index operator,
- **2.3.3** Slice operator,
- **2.3.4** Tuple assignment,
- **2.3.5** Tuple as a return value

Unit III: Iterations and Conditional statements

3.1 Conditional and alternative statements, Chained and Nested Conditionals: if, if-else, if-elif-else, nested if, nested if-else.

3.2 Looping statements such as while, for etc, Tables using while.

3.3 Functions:

- **3.3.1** Calling functions: type, id
- **3.3.2** Type conversion: int, float, str
- **3.3.3** Composition of functions, Returning values from functions
- **3.3.4** User defined functions, Parameters and arguments

Unit IV: 2D and 3D Graphs

4.1 Installation of numpy, matplotlib packages.

4.2 Graphs plotting of functions.

4.3 Different formats of graphs, PyDotPlus (Scalable Vector Graphics), PyGraphviz.

4.4 Three-dimensional Points and Lines.

4.5 Three-dimensional Contour Plots, Wireframes and Surface Plots.

ESSENTIAL/RECOMMENDED READINGS:

1. Allen Downey, Think Python, How to Think Like a Computer Scientist, Green Tea Press

Needham, Massachusetts, 2015,
Unit-1: Chapter-1: 1.1-1.5, Chapter-2: 2.1-2.6, Chapter-3: 3.1-3.6, Chapter-5: 5.1-5.3
Unit-2: Chapter-8: 8.1-1.5, Chapter-10: 10.12, Chapter-12: 12.1.- 12.6
Unit-3: Chapter 5:5.4 -5.7, Chapter 7: 7.1-7-7.5

2. Robert Johansson, Introduction to Scientific Computing in Python, 2016
Unit-1: 6.5-6.8
Unit-4: Chapter-5
3. Hans-Petter Halvorsen, Python for Scientific engineering, 2020

Reference Books:

1. Lambert K. A., Fundamentals of Python - First Programs, Cengage Learning India, 2015.
2. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India.
3. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015.Zelle, J., Python
4. Programming: An Introduction to Computer Science, Franklin, Beedle and Assiciatesn Inc. SandroTosi, Matplotlib for Python Developers, Packt Publishing Ltd. (2009) BIRMINGHAM MUMBAI. (Use for 2D and 3D plots and also use Lambert K. A book).
5. Python: Notes for Professionals, Goalkicker.com, Free Programming books.

List of Practicals:

Practical 1: Introduction to Python, Python Data Types-I (Unit 1)
Practical 2: Practical on Arithmetic Operators in Python (Unit 1)
Practical 3: Math Module, Cmath module & input statement (Unit 1)
Practical 4: Strings (Unit 2)
Practical 5: Lists (Unit 2)
Practical 6: Tuples (Unit 2)
Practical 7: Control Statements in Python-I (Unit 3)
Practical 8: Control Statements in Python-II (Unit 3)
Practical 9: Looping Statements (Unit 3)
Practical 10: Functions (Unit 3)
Practical 11: 2D Graph Plotting (Unit 4)
Practical 12: 3D Graph Plotting (Unit 4)

INDIAN KNOWLEDGE SYSTEM (MT-IKS-116T): Vedic Mathematics

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-IKS-116T- Vedic Mathematics	2	2	--

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- To enable the learners to know the history of Vedic mathematics and how the ancient mathematicians invent the Vedas and Śulva Sūtras, Place Value System and various Arithmetic Operations.
- To enable the learners to explore the power and techniques of Vedic Mathematics.
- To make learners strong in Numerical Mathematics.
- To enable learners to recognize and understand simple techniques of Arithmetic calculations and geometric construction.
- To train learners to use the ideas of Vedic Mathematics in daily calculations and make those calculations with accuracy and speed.

COURSE OUTCOMES:

After completion of this course, a student will able to;

CO-1: Know the history of Vedic mathematics and how the ancient mathematicians invent the Vedas and Śulva Sūtras, Place Value System and various Arithmetic Operation

CO-2: Know the work done by the Indian mathematician in the medieval and during Classical age.

CO-3: Perform simple arithmetic calculations with speed and accuracy will be able to generate tables of any number and find squares, cubes of given numbers quickly.

CO-4: Develop confidence in calculating square roots and cube roots of integers.

CO-5: Perform difficult calculations speedily.

CO-6: Face Numerical Aptitude part of any Competitive Examination confidently.

SYLLABUS OF MT-IKS -116T: Vedic Mathematics

Unit-I: Mathematics in Ancient India **[06 Hours]**

1.1 Indian contributions to decimal systems and place value.

1.2 The mathematical sophistication of the Harappan culture.

1.3 The vedic period and the Sulva geometry.

1.4 The contribution of the Jainas.

1.5 The Baksali manuscript.

1.6 Chandas Sutra of Pingala and Binary Arithmetic.

Unit-II: Mathematics in the Medieval India and during Classical age [08 Hours]

2.1 Aryabhata
2.2 Brahmagupta
2.3 Bhaskaracarya II
2.4 Mathematics in Medieval India

Unit-III: Techniques of Vedic Mathematics [10 Hours]

3.1 Various techniques to carry out basic operations covering Addition, Subtraction, Multiplication, Division,
3.2 General multiplication (Vertically Crosswise),
3.3 Squares
3.4 Square roots
3.5 Cubes
3.6 Cube roots

Unit-IV: Quadratic and Simultaneous Equations [06 Hours]

4.1 Quadratic Equations.
4.2 Simultaneous Equations
4.3 Use of various Vedic Techniques for answering numerical aptitude questions from Competitive Examinations

ESSENTIAL/RECOMMENDED READINGS:

1) G. G. Emch, M. D. Srinivas and R. Sridharan, Eds., Contributions to the History of
2) Mathematics in India, Hindustan Book Agency, Delhi, 2005. (Unit-I,Unit-II)
3) B. Datta and A. N. Singh, History of Hindu Mathematics, 2 Parts, Lahore, 1935, 1938;
4) Reprint, Asia Publishing House, Bombay 1962; Reprint, Bharatiya Kala Prakashan, Delhi 2004.
5) T. A. Saraswati Amma, Geometry in Ancient and Medieval India, Motilal Banarsidass, Varanasi, 1979.
6) Bhatiya Dhaval, Vedic Mathematics Made Easy, Jaico Publishing House
7) Thakur Rajesh Kumar, Vedic Mathematics for students taking Competitive Examinations. Unicorn Books 2015 or Later Edition
8) Gupta Atul, Power of Vedic Mathematics with Trigonometry, Jaico Books
9) C. N. Srinivasiengar, History of Indian Mathematics, The World Press, Calcutta, 1967

Syllabus for F.Y.B.Sc. (Mathematics)

Semester II

DISCIPLINE SPECIFIC CORE COURSE (MT-MJ-121T):
Analytical Geometry

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-MJ-121T - Analytical Geometry	2	2	--

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- Learn how to determine the position of point or object in three-dimensional co- ordinate system.
- Learn the transformation of old co-ordinate system to new co-ordinate system by translation and rotation.
- Understand and visualize the behavior of line, plane and sphere in three-dimensional co-ordinate geometry.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Transform old co-ordinate system to new co-ordinate system by translation and rotation, reduce the general equation of second degree into standard form of conic.

CO-2: Understand and solve the problems on concept of lines and planes in three dimensions.

CO-3: Determine how geometry is related to algebra by using their algebraic equations.

CO-4: Recognize the different forms of equation of the sphere and apply them to solve the problems.

SYLLABUS OF MT-MJ-121T: Analytical Geometry

Unit I: Analytical Geometry of Two Dimension **[07 Hours]**

1.1. Change of axes: translation and rotation.

1.2. Conic Sections: General equation of second degree in two variables

1.3. Reduction to standard form, centre of conic, nature of conic.

Unit II: Planes **[08 Hours]**

2.1. Direction cosines and direction ratios, Equation of plane, Normal form, transform to the normal form, Plane passing through three non-collinear points, Intercept form, Angle between two planes.

2.2. Distance of a point from a plane, Distance between parallel planes, Systems of planes, two sides of planes, Bisector planes.

Unit III: Lines in three dimension [07 Hours]

3.1. Equations of a line in Symmetric and unsymmetrical forms, Line passing through two points, Angle between a line and a plane.

3.2. Perpendicular distance of a point from a plane, Condition for two lines to be coplanar (without proof).

Unit IV: Sphere [08 Hours]

4.1. Equation of a sphere in different forms, plane section of a sphere.

4.2. Equation of a circle, sphere through a given circle

4.3. Intersection of a sphere and a line, Equation of tangent plane to sphere.

ESSENTIAL/RECOMMENDED READINGS:

1. Analytic Geometry in Two and Three Dimensions: Von Steuben Unit1: Sec, 8.4
2. Analytical Solid Geometry: Shantinarayan; S. Chand and Company Ltd, New Delhi, 1998. Unit2: Sec. 1.6, 1.7, Sec. 2.1 to 2.7 Unit3: Sec. 3.1 to 3.4, 3.7 Unit4: Sec. 6.1 to 6.6.
3. P. K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.

DISCIPLINE SPECIFIC CORE COURSE (MT-MJ-122T): Calculus-II

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-MJ-122T: Calculus-II	2	2	--

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- Relate the values of a function to values of its derivative in real analysis by using the Mean Value Theorem.
- Provide students with an introduction to the theory of ordinary differential equations through applications, methods of solution.
- Determine the order, degree and solution of a differential equation,
- Classify the differential equations with respect to their order and linearity.
- Evaluate first order differential equations including separable, homogeneous, exact, and linear.

COURSE OUTCOMES:

After completion of this course student will able to;

CO-1: Learn geometrical representation and problem solving on MVT and Rolls theorems.

CO-2: Identify and apply the intermediate value theorems and L'Hospital rule

CO-3: Recognize differential equations that can be solved by various methods and use the appropriate method to solve them

CO-4: Solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.

CO-5: Apply the concept of differential equations to solve problems such as orthogonal trajectories.

SYLLABUS OF MT-MJ-122T: Calculus-II

Unit I: Mean Value theorems **[12 Hours]**

1.1 Mean Value Theorems: Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem

1.2 Indeterminate forms. L-Hospitals rule (without proof).

1.3 Higher order derivatives, examples, Leibnitz Theorem and its applications

1.4 Taylor's and Maclaurin's Theorem with Lagrange's form of remainder (without proof), Examples

Unit II: Differential Equations of first order and first degree: [10 Hours]

2.1 Introduction to function of two, three variables, homogenous functions, Partial derivatives.

2.2 Differential equations, Formation of Differential equation, General solution of Differential equations.

2.3 Methods of finding solution of Differential equations of first order and first Degree: Variable separable form, Homogenous Differential equations, Differential equations reducible to homogeneous form, Initial value problem.

Unit III: Exact Differential equations. [08 Hours]

3.1 Differential equations reducible to exact Differential equations, integrating factors, Linear Differential equations, Bernoulli's Differential equations.

3.2 Application of Differential Equations- Orthogonal trajectories.

ESSENTIAL/RECOMMENDED READINGS:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons, Inc., Fourth Edition.
   Unit I: Chapter 6: Sec 6.2(6.2.1 to 6.2.8), Sec 6.3(6.3.1 to 6.3.7), Sec 6.4(6.4.1 to 6.4.3).
2. Ordinary and partial Differential equations,M.D. Raisingania, S. Chand and Company, 2009.
   Unit II: Chapter 1: 1.1 to 1.7, Chapter 2: 2.2 to 2.10.
   Unit III: Chapter 2: 2.12 to 2.27, Chapter 3: 3.1 to 3.5

DISCIPLINE SPECIFIC CORE COURSE (MT-MJ-123P): Practical Based on Analytical Geometry and Calculus-II

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-MJ-123P: Practical Based on Analytical Geometry and Calculus-II	2	--	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- Acquire the knowledge necessary to apply basic concepts of Analytical Geometry and calculus, other contemporary mathematical tools.
- Improve student's analytical, cognitive, and computational skills by solving the problems of Analytical Geometry and Calculus.

COURSE OUTCOMES:

After completion of this course student will be able to:

CO-1: Improve the ability of students to solve the on three-dimensional coordinate system and their transformation to new co-ordinate system.
CO-2: Solve the most difficulties possible strengthens theoretical notions.
CO-3: Clarify their doubts about the concepts of analytical Geometry in three dimensions and calculus by solving the problems because of one-to-one interaction with the teacher.
CO-4: Gain the ability to use mathematical ideas to solve practical and everyday issues.
CO-5: Develop interdisciplinary approach.

SYLLABUS OF MT-MJ-123P: Practical Based on Analytical Geometry and Calculus-II

(Practical based on the applications of articles in MT-MJ- 121T and MT-MJ- 122T)

In Semester-II, we should conduct 4 written practical and 2 practicals on maxima software for each paper MT-MJ- 121T and MT-MJ- 122T.

List of Practicals

Practical 1: Problems on Unit 1 (Written) from MT-MJ- 121T.
Practical 2: Problems on Unit 2 (Written) from MT-MJ- 121T.
Practical 3: Problems on Unit 3(Written) from MT-MJ- 121T.

Practical 4: Problems on Unit 4(Written) from MT-MJ- 121T.
Practical 5: Problems on unit 1 and unit 2 from MT-MJ- 121T using maxima software.
Practical 6: Problems on Unit 3 and Unit 4 from MT-MJ- 121T using maxima software.
Practical 7: Problems on Unit 1 (Written) from MT-MJ- 122T.
Practical 8: Problems on Unit 2 (Written) from MT-MJ- 122T.
Practical 9: Problems on Unit 3(Written) from MT-MJ- 122T.
Practical 10: Problems on Unit 4(Written) from MT-MJ- 122T.
Practical 11: Problems on unit 1 and Unit 2 from MT-MJ- 122T using maxima software.
Practical 12: Problems on Unit 3 and Unit 4from MT-MJ- 122T using maxima software.

Note:

1 The soft copy of practical on maxima software will be prepared and provided by the Board of studies in mathematics.

2. Practicals on maxima software can be performed on computer and android mobiles.

3. Android mobiles are allowed for practical examination on maxima software.

4. Practical examination 25 marks on written problems, 10 marks for problems on maxima software

(5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

VOCATIONAL SKILL COURSE (MT-VSC-124T): Latex for Scientific Typing

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-VSC-124P: Latex for Scientific Typing	2	2	--

LEARNING OBJECTIVES

The Learning Objectives of this course are as follows:

- Provide an understanding of the basic mechanisms of LaTeX, using plain text as a vehicle
- Acquaint students with the latest typesetting skills, this shall enable them to prepare high quality type setting.

COURSE OUTCOMES

After completion of this course student will be able to:

CO-1: Write a simple LaTeX input document based on the article class.
CO-2: Turn the input document into pdf with the pdf latex program.
CO-3: Format Words, Lines, and Paragraphs.
CO-4: Understand how to present data using tables.

SYLLABUS OF MT-VSC-124P: Latex for Scientific Typing

Unit I: Introduction to LaTeX

1.1 Definition and application of LaTeX.
1.2 Preparation and Compilation of LaTeX input file.
1.3 LaTeX Syntax.
1.4 Keyboard Characters in LaTeX.

Unit II: Formatting Words, Lines, and Paragraphs

2.1 Text and Math Mode Fonts.
2.2 Emphasized and Colored Fonts.
2.3 Sectional Units.
2.4 Labeling and Referring Numbered Items.
2.5 Texts Alignment and Quoted text.
2.6 New Lines and Paragraphs.

2.7 Creating and Filling Blank Space.
2.8 Producing Dashes Within Texts.

Unit III: Listing and Tabbing Texts
3.1 Listing Texts.
3.2 Tabbing Texts Through the tabbing Environment.

Unit IV: Table Preparation
4.1 Table Through the tabular Environment.
4.2 Table Through the tabularx Environment.
4.3 Vertical Positioning of Tables.
4.4 Sideways (Rotated) Texts in Tables.
4.5 Adjusting Column Width in Tables.
4.6 Additional Provisions for Customizing Columns of Tables.
4.7 Merging Rows and Columns of Tables.

12 Practicals based on Latex for Scientific Typing:
Practical 1: Introduction to LaTeX (Unit-1; 1.1, 1.2)
Practical 2: Syntax and Keyboard Characters in LaTeX (Unit-1; 1.3, 1.4)
Practical 3: Fonts in LaTeX (Unit -2; 2.1, 2.2)
Practical 4: Sections, Labelling and Text Alignment in LaTeX (Unit-2; 2.3, 2.4, 2.5)
Practical 5: New Lines, Paragraphs, Blank Space and Dashes in LaTeX (Unit-2; 2.6-2.8)
Practical 6: Listing Texts -I (Unit-3; 3.1[Chapter 6, 6.1.1, 6.1.2])
Practical 7: Listing Texts -II (Unit-3; 3.1[Chapter 6, 6.1.3, 6.1.4, 6.1.5])
Practical 8: Tabbing Texts (Unit-3; 3.2)
Practical 9: Table Through the tabular Environment (Unit-4; 4.1)
Practical 10: Table Through the tabularx Environment (Unit-4; 4.2)
Practical 11: Positioning and Texts in Tables (Unit-4; 4.3, 4.4)
Practical 12: Customizing Tables in LaTeX (Unit-4; 4.5, 4.6, 4.7)

ESSENTIAL/RECOMMENDED READINGS:

1. LaTeX in 24 Hours, A Practical Guide for Scientific Writing, Dilip Datta, Springer International Publishing AG, 2017.
   Unit 1: Chapter 1; 1.1 to 1.6, Unit 2: Chapter 2; 2.1 to 2.4, Chapter 3; 3.1 to 3.7
   Unit 3: Chapter 6; 6.1, 6.2, Unit 4: Chapter 7; 7.1 to 7.7
2. LaTeX, A Document Preparation System, User's Guide and Reference Manual, Leslie Lamport, Addison-Wesley Publishing Company, Inc., 1994.
3. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing Ltd, 2011.
4. LaTeX and Friends, M.R.C. van Dongen, Springer-Verlag Berlin Heidelberg ,2012.

SKILL ENHANCEMENT COURSE (MT-SEC-125P): Basics of Machine Learning

Course Code &Title	Credits	Credit Distribution of the Course	
		Theory	Practical
MT-SEC-125P: Basics of Machine Learning	2	--	2

LEARNING OBJECTIVES:

The Learning Objectives of this course are as follows:

- Introduce students to the basic concepts and techniques of Machine Learning.
- Become familiar with introduction to NumPy Array and Matrices.
- Become familiar with discover and visualize data to gain insights.
- Become familiar with Fine-tuning the model - Grid Search, Randomized Search.
- Develop the ability to write database applications in Python.

COURSE OUTCOMES:

After completion of this course student will be able to:

CO-1: Gain knowledge about basic concepts of Machine Learning.
CO-2: Identify machine learning techniques suitable for a given problem.
CO-3: Solve the problems using various machine learning techniques.

SYLLABUS OF MT-SEC-125P: Basics of Machine Learning

Unit I: Introduction to Machine Learning

1.1 What & why behind machine learning
1.2 Types of Machine Learning - Supervised vs Unsupervised
1.3 Model Based Training
1.4 Main challenges of Machine Learning
1.5. Testing and Validating

Unit II: Introduction to Python

2.1 The Way of The Program
2.2 Variables, Expressions and Statements
2.3 Functions
2.4 Conditionals and Recursion
2.5 Strings
2.6 Lists

Unit III: Understanding ML related Python Packages

3.1 Numpy Basics: Arrays and Vectorized Computation
1. The NumPy ndarray: A Multidimensional Array Object
2. Universal Functions: Fast Element-wise Array Functions
3. Data Processing Using Arrays

3.2 Getting Started with Pandas
1. Introduction to pandas Data Structures
2. Essential Functionality
3. Summarizing and Computing Descriptive Statistics
4. Handling Missing Data
5. Hierarchical Indexing

3.3 Plotting and Visualization
1. A Brief matplotlib API Primer
2. Plotting Functions in Pandas
3. Plotting Maps: Visualizing Haiti Earthquake Crisis Data

12 Practicals based on above topics (Basics of Machine Learning)

ESSENTIAL/RECOMMENDED READINGS:

1. Hands-on Machine Learning with Scikit-Learn, Keras and Tensorflow – Aurelien Heron, Sections: 1, 2
2. Python for Data Analysis by Wes McKinney (O' Reilly publication) Chapter -4:4.1, 4.2, 4.3, 4.5, Chapter -5: 5.1, 5.2, 5.3, 5.4, 5.5, Chapter-8: 8.1, 8.2, 8.3
3. Allen Downey, Think Python, How to Think Like a Computer Scientist, Green Tea Press Needham, Massachusetts, 2015, Sections - 1, 2, 3, 5, 8, 10
4. Introduction to Machine Learning with Python - Andreas C. Muller & Sarah Guide
5. Head first Python by Paul Barry (O Reilly publication)
6. Jason Brownlee - Basics of Linear Algebra for Machine Learning, 2018
7. M. P. Deisenroth, A. A. Faisal, C. S. Ong - Mathematics for Machine Learning, Cambridge University Press, 2019
8. Dipanjan Sarkar, Raghav Bali, Tushar Sharma - Practical Machine Learning with Python, 2018.
9. Extra Reference Resources - geeksforgeeks.org/machine-learning https://towardsdatascience.com/search?q=machine%20learningwww.kaggle.com