Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Four Year B.Sc. Degree Program in Mathematics

(Faculty of Science & Technology)

CBCS Syllabus

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

For Department of Mathematics

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2023-2024

Title of the Programme: F.Y.B.Sc. (Mathematics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Mathematics and related subjects, the Board of Studies in Mathematics at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of F.Y.B.Sc. Mathematics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A Mathematics degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Graduates in Mathematics find opportunities in various fields, including Financial Planner, Market Research Analyst, Data Scientist, teaching, Insurance underwriter, operations research analyst, software developer, and many other domains. After graduating with a degree in mathematics, students can embark on a multitude

of rewarding and diverse career paths. The analytical and problem-solving skills honed during their studies equip them with a strong foundation for success in various fields. Many graduates choose to pursue careers in academia and research, where they can contribute to the advancement of mathematical knowledge through teaching, publishing papers, and conducting ground breaking research. Others may opt for careers in the financial sector, such as investment banking or actuarial science, utilizing their expertise in mathematical modelling and statistical analysis to make informed decisions and manage risks. Additionally, the field of data science offers abundant opportunities for mathematics graduates, as they possess the ability to extract meaningful insights from complex data sets and develop algorithms that drive innovation in industries like technology, healthcare, and marketing. Moreover, mathematics graduates can find fulfilling careers in engineering, cryptography, software development, and operations research, to name just a few areas where their mathematical skills are highly sought after. Overall, a degree in mathematics opens doors to a wide range of intellectually stimulating and financially rewarding professions, allowing graduates to make significant contributions to society and thrive in a rapidly evolving world.

Overall, revising the Mathematics syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO 1-Proficiency in Mathematical Concepts: Graduates will have a deep understanding of fundamental mathematical concepts and theories across various branches of mathematics, including calculus, algebra, geometry, probability, and statistics.

PSO 2-Problem-Solving Skills: Graduates will possess strong problem-solving skills and the ability to apply mathematical principles to real-world situations. They can analyze complex problems, develop logical reasoning, and devise creative strategies to find solutions.

PSO 3-Mathematical Modeling: Graduates will be proficient in mathematical modeling, which involves using mathematical techniques to describe and analyze real-world phenomena. They can formulate and solve mathematical models to address problems in diverse fields, including physics, economics, engineering, and social sciences.

PSO4-Computational and Analytical Skills: Graduates will be skilled in using computational tools and software, such as programming languages, statistical software, and mathematical modeling software. They can leverage these tools to perform numerical analysis, data visualization, and simulations.

PSO 5-Communication and Presentation: Graduates will possess effective communication skills, both written and oral, to convey complex mathematical ideas and results to both technical and non-technical audiences. They can present mathematical arguments, proofs, and findings in a clear and concise manner.

PSO 6-Research and Inquiry: Graduates will have the ability to engage in mathematical research and inquiry. They can critically evaluate existing mathematical theories, develop new mathematical models, and contribute to the advancement of mathematical knowledge through independent research or collaborative projects.

PSO 7-Interdisciplinary Collaboration: Graduates will be adept at collaborating with professionals from other disciplines, such as scientists, engineers, economists, and computer scientists. They can effectively communicate and work in multidisciplinary

teams to solve complex problems that require mathematical expertise.

PSO 8-Lifelong Learning: Graduates will have developed a strong foundation for lifelong learning in mathematics. They will have the skills to stay abreast of new developments in the field, adapt to emerging technologies and methodologies, and continue their professional growth through self-directed study or advanced academic pursuits.

PSO 9-Advanced Mathematical Techniques: Graduates will have a command of advanced mathematical techniques, such as differential equations, mathematical analysis, linear algebra, number theory, and optimization. They can apply these advanced mathematical tools to solve complex problems and contribute to specialized areas of research.

PSO 10-Mathematical Software Development: Graduates will possess programming skills and the ability to develop mathematical software or algorithms. They can design, implement, and optimize software applications that facilitate mathematical calculations, simulations, data analysis, and modeling.

PSO 11-Mathematical Education and Teaching: Graduates interested in pursuing a career in education will have the necessary skills to teach mathematics at various levels. They can design and deliver effective lessons, develop curriculum materials, and assess student progress in mathematics. They can also inspire and motivate students to develop an appreciation for the subject.

PSO 12-Mathematical Finance and Risk Analysis: Graduates with an interest in finance and economics will have specialized knowledge in mathematical finance and risk analysis. They can apply mathematical models, stochastic calculus, and statistical methods to analyze financial markets, manage investment portfolios, assess risk, and make informed financial decisions.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Board of Studies (BOS) in Mathematics

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	Mr. Sadashiv R. Puranik,	Chairman
2.	Ms. Varsha H. Shinde	Member
3.	Dr. Prakash B. Fulari	Member
4.	Ms. Shaila S. Jadhav	Member
5.	Ms. Nikita R. Shinde	Member
6.	Ms. Sonali V. Kate	Member
7.	Dr. Anil S. Khairnar	Vice-Chancellor Nominee
8.	Dr. Nitin S. Darkunde	Expert from other University
9.	Dr. Kishor D. Kucche	Expert from other University
10.	Mr. Amit Patil	Industry Expert
11	Dr. Haribhau R. Bhapkar	Meritorious Alumni
12.	Ms. Pranali Jadhav	Student Representative
13.	Ms. Ankita Anpat	Student Representative

Credit Distribution Structure for F.Y.B.Sc.-2023-2024 (Mathematics)

Level	Semester	Major		Minor	OE	VSC, SEC, (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr/Sem	Degree/ Cum.Cr.
		Mandatory	Electives							
4.5										UG Certificate 44 credits
	I	**MAT-101-MJM**: Algebra **(2 Credits)** **MAT-102-MJM**: Calculus **(2 Credits)** **MAT-103-MJM**: Mathematics Practical I **(2 Credits)**			**MAT-116-OE:** Basic Mathematics I **(2 Credits)** **MAT-117-OE:** Applied Mathematics I **(2 Credits)**	**MAT-121-VSC:** Logical Methods **(2 Credits)** **MAT-126-SEC:** Scilab and Maxima Software- I **(2 Credits)**	**ENG-131-AEC :** Functional English-I **(2 Credits)** **MAT-135-VEC:** Mathematics for Environmental Science **(2 Credits)** **MAT-137-IKS:** Vedic Mathematics **(2 credits)**	CC1 (2 credit)	22	
	II	**MAT-151-MJM**: Geometry **(2 Credits)** **MAT-152-MJM**: Calculus and Differential Equations **(2 Credits)** **MAT-153-MJM**: Mathematics Practical II **(2 Credits)**		**MAT-161-MN**: Fundamentals of Mathematics **(2 Credits)**	**MAT-166-OE:** Basic Mathematics II **(2 Credits)** **MAT-167-OE:** Applied Mathematics II **(2 Credits)**	**MAT-171-VSC:** Geogebra Software **(2 Credits)** **MAT-176-SEC:** Scilab and Maxima Software- II **(2 Credits)**	**ENG-181-AEC :** Functional English-II **(2 Credits)** **COS-185-VEC:** Digital and Technological Solutions **(2 Credits)**	CC2 (2 credit)	22	
	Cum Cr.	**12**	--	2	8	8	10	4	44	

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Course Structure for F.Y.B.Sc. Mathematics (2023 Pattern)

Sem	Course Type	Course Code	Course Name	Theory / Practical	Credits
I	Major Mandatory	MAT-101-MJM	Algebra	Theory	02
	Major Mandatory	MAT-102-MJM	Calculus	Theory	02
	Major Mandatory	MAT-103-MJM	Mathematics Practical I	Practical	02
	Open Elective (OE)	MAT-116-OE	Basic Mathematics I	Theory	02
	Open Elective (OE)	MAT-117-OE	Applied Mathematics I	Practical	02
	Vocational Skill Course (VSC)	MAT-121-VSC	Logical Methods	Theory	02
	Skill Enhancement Course (SEC)	MAT-126-SEC	Scilab and Maxima Software I	Practical	02
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English-I	Theory	02
	Value Education Course (VEC)	ENV-135-VEC	Environmental Science	Theory	02
	Indian Knowledge System (IKS)	MAT-137-IKS	Vedic Mathematics	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
				Total Credits Semester-I	**22**
II	Major Mandatory	MAT-151-MJM	Geometry	Theory	02
	Major Mandatory	MAT-152-MJM	Calculus and Differential Equations	Theory	02
	Major Mandatory	MAT-153-MJM	Mathematics Practical II	Practical	02
	Minor	MAT-161-MN	Fundamentals of Mathematics	Theory	02
	Open Elective (OE)	MAT-166-OE	Basic Mathematics II	Theory	02
	Open Elective (OE)	MAT-167-OE	Applied Mathematics II	Practical	02
	Vocational Skill Course (VSC)	MAT-171-VSC	Geogebra Software	Practical	02
	Skill Enhancement Course (SEC)	MAT-176-SEC	Scilab and Maxima Software II	Practical	02
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English-II	Theory	02
	Value Education Course (VEC)	COS-185-VEC	Digital and Technological Solutions	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
				Total Credits Semester-II	**22**
				Cumulative Credits Semester I + Semester II	**44**

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Major Mandatory
Course Name : Geometry
Course Code : MAT-151-MJM
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Understand an apply the concept of locus of points in analytical geometry.
2. Master the techniques of translating and rotating coordinate axes.
3. Analyze and determine the centre of a conic.
4. Apply techniques for reducing equation to standard form.
5. Acquire skills in working with rectangular Cartesian coordinates in three dimensions.
6. Learn to find direction cosines and angle between lines using direction cosines.
7. Master the determination of planes under given conditions and understand the concept of system of planes
8. Develop the ability of finding the shortest distance between skew lines and length of perpendicular from point to line.
9. Understand the fundamental concepts and properties of spheres.
10. Develop the ability to determine and apply the equation of a tangent plane to a sphere, demonstrating a clear understanding of this geometric concept.

Course Outcomes:

By the end of the course, students will be able to:

1. Demonstrate proficiency in performing translations and rotations of coordinate axes.
2. Reduce equations to standard forms and determine various properties associated with them.
3. Understand rectangular Cartesian coordinates in three dimensions and use them in various scenarios.
4. Calculate direction cosines and angle between lines using coordinate geometry techniques.
5. Find the shortest distance between skew lines and length of perpendicular from points to lines in three dimensions.
6. Analyze plane sections of spheres and solve problems involving the intersection of two spheres.
7. Determine and apply the equation of tangent plane to a sphere, illustrating a high-level proficiency in this advanced geometric concept.

Topics and Learning Points

	Teaching Hours
Unit 1: Analytical Geometry of two dimensions	**6**
1.1 Locus of points and change of axes (Translation and Rotation)	
1.2 General equation of second degree	
1.3 Centre of conic	
1.4 Reduction of equation of conic to its standard form	
Unit 2: Planes in three dimensions	**8**
2.1 Rectangular Cartesian coordinates of points in space	
2.2 Direction cosines and angle between two lines	
2.3 Equation of first degree in x, y, z.	
2.4 Normal form of equation of plane	
2.5 Determination of plane under given conditions	
2.6 System of planes	
2.7 Two sides of plane	
2.8 Length of perpendicular and bisector of angles between two planes	
2.9 Joint equation of two plane	
Unit 3: Lines in three dimensions	**8**
3.1 Equations of lines (Symmetric and asymmetric forms)	
3.2 Angle between the line and a plane	
3.3 Coplanar lines	
3.4 Skew lines and distance between skew lines	
3.5 Length of perpendicular from a point to the line	
Unit 4: The Sphere	**8**
4.1 Definition and equation of the sphere in various forms	
4.2 Plane section of the sphere	
4.3 Intersection of two spheres	
4.4 Equation of circle and sphere through a given circle	
4.5 Intersection of a sphere and a line	
4.6 Equation of a tangent plane	

Text Books:

1. Von Steuben, Analytic Geometry in two and three dimensions
   Unit 1 – Section 8.4
2. Shanti Narayan and P. K. Mittal, Analytical Solid Geometry, S. Chand
   Unit 2 – Sections 1.6, 1.7, 2.1 to 2.7, **Unit 3** – Sections 3.1 to 3.4 and 3.7,
   Unit 4 – Sections 6.1 to 6.6

Reference Books:

1. George Thomas and Ross Finney, Calculus and Analytical Geometry, Pearson Education.
2. E. H. Askwyth, The Analytical Geometry of the conic section
3. P. K. Jain and Khalil Ahmed, A text book of Analytical Geometry of three dimensions, Wiley Eastern Ltd.
4. L. P. Eisenhart, Coordinate Geometry, The World Press Pvt. Ltd.
5. Gordan Fuller and Robert Parker, Analytical Geometry and Calculus, D. Van Nastrand.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of Programme : B. Sc. (Mathematics)
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Major Mandatory
Course Name : Calculus and Differential Equations
Course Code : MAT-152-MJM
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. The primary objective of the course is to introduce students to the concepts of calculus and to develop the student's confidence and skill in dealing with mathematical expressions in various fields.
2. To understand the idea of differentiation from first principles.
3. To understand and work with derivatives as rates of change in Mathematical models.
4. To understand use of both graphical and numerical methods.
5. To introduce the concept of integration, study various techniques of integration and illustrate some applications of integration.
6. To learn about solutions of first order differential equations.
7. To understand that physical systems can be described by differential equations.

Course Outcomes:

By the end of the course, students will be able to:

1. To understand the definition of the derivative and able to find the derivative of a function of one variable.
2. To apply mean value theorems and extreme value theorems for derivatives in the problems.
3. To find the nature of graphs of functions of one variable using derivative.
4. To compute integrals and analyze functions using integrals.
5. To use basic integration properties to solve graphical net area problems.
6. To determine the rate of change of a quantity with respect to another quantity.
7. To Recognize the appropriate tools of Calculus and Differential Equations to solve applied problems.

Topics and Learning Points

	Teaching Hours
Unit 1: Differentiation	**12**
1.1 The Derivative	
1.2 The Mean Value Theorem	
1.3 L'Hospital Rules	
1.4 Taylor's Theorem	
Unit 2: Riemann Integration	**8**
2.1 Riemann Integral	
2.2 Riemann Integrable Functions	
2.3 The Fundamental Theorem	
Unit 3: Differential Equation	**10**
3.1 Introductory Remarks	
3.2 The Nature of Solutions	
3.3 Separable Equations	
3.4 First Order linear Equations	
3.5 Exact Equations	
3.6 Orthogonal Trajectories and Families of Curves	

Text Books:

1. **Introduction to Real Analysis by Robert.G. Bartle and Donald.R. Sherbert, John Wiley and Sons Inc, Fourth Edition**.
   Unit 1: Chapter 6:Sec 6.1 to Sec. 6.4
   Unit 2: Chapter 7:Sec 7.1 to 7.3
2. **Differential Equations by George F. Simmons, Steven G. Krantz, Tata McGraw-Hill.**
   Unit 3: Chapter 1**:**Sec 1.1 to Sec 1.6

Reference Books:

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.
2. Calculus of a single variable Ron Larson, Bruce Edwards, tenth edition.
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.
5. Ordinary and Partial Differential Equation, by M. D. Raisinghania, S. Chand and Company LTD, 2009.
6. Daniel Murray, Introductory Course in Differential Equations, Orient Longman.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Major Mandetory
Course Name : Mathematics Practical II
Course Code : MAT-153-MJM
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Demonstrate proficiency in translating and rotating coordinate axes.
2. Transform equations of conic sections to their standard forms.
3. Determine planes under given conditions and understand systems of planes.
4. Formulate equations of lines in both symmetric and asymmetric forms.
5. Identify and analyze coplanar lines.
6. Analyze plane sections of a sphere, intersections of two spheres and intersection of a sphere and a line.
7. Understand and apply the Mean Value Theorem in a practical context.
8. Gain confidence in handling complex limits using L'Hôpital's Rule.
9. Apply Taylor's series to approximate function values near the given point.
10. Gain proficiency in evaluating definite integrals using Riemann sums and limits.
11. Understand the nature of solutions for differential equations and their implications in various fields.
12. Develop proficiency in identifying and working with families of curves and their orthogonal trajectories.

Course Outcomes:

By the end of the course, students will be able to:

1. Proficiently translate and rotate coordinate axes to reposition geometric figures. Additionally, they will demonstrate the ability to convert equations of conic sections into their standard forms, facilitating easier analysis and manipulation.
2. Gain the capability to determine planes under specified conditions. They will also develop a deep understanding of systems of planes, enabling them to solve complex spatial problems involving multiple planes.
3. Master the formulation of line equations in both symmetric and asymmetric forms. They will also be proficient in identifying and analyzing coplanar lines, a crucial skill in spatial geometry and related applications.
4. Demonstrate competence in analyzing various aspects of spheres, including plane sections, intersections of two spheres, and intersections of a sphere with a line. This proficiency will equip them to solve intricate problems involving spheres in three-dimensional space.
5. Demonstrate the ability to apply mathematical concepts, including the Mean Value Theorem, L'Hôpital's Rule, Taylor's series, Riemann integration, and solving differential equations, to solve a variety of analytical problems.
6. Demonstrate the ability to apply mathematical concepts and techniques, such as finding orthogonal trajectories, in practical contexts across various disciplines.

Topics and Learning Points

Teaching Hours

Geometry Practicals: **30**

1. Locus of Points and Change of Axes
2. General Equation of Second Degree
3. Centre of Conic and Reduction of Equation
4. Determination of Plane under Given Conditions
5. Length of Perpendicular from a Point to a Line
6. Intersection of Two Spheres and Equation of Circle/Sphere through a Given Circle

Calculus and Differential Equations Practicals: **30**

1. Derivative and Mean Value Theorem
2. L'Hôpital's Rule
3. Taylor's Theorem
4. Riemann Integration
5. Differential Equations
6. Orthogonal Trajectories

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Minor
Course Name : Fundamentals of Mathematics
Course Code : MAT-161-MN
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Develop a solid foundation in fundamental mathematical concepts related to real numbers, operations, and their properties.
2. Introduce the concept of limits, understand their properties, and apply them to investigate the continuity of functions at specific points.
3. Develop a comprehensive understanding of trigonometric functions, their properties, and the various trigonometric identities.
4. Learn how to use the coordinate plane to represent geometric figures, calculate distances, and determine equations of lines and curves.
5. Learn how to use derivatives to solve practical problems in various fields such as physics, economics, and engineering, including rates of change and optimization.
6. Study the behavior of functions to identify and analyze critical points, determine local maxima and minima, and solve optimization problems.
7. Learn how to use integrals to solve practical problems in various fields such as physics, economics, and engineering, including calculating areas, volumes, and accumulated quantities.
8. Introduce the concept of differential equations, and develop skills in solving basic first-order differential equations using analytical and numerical methods.

Course Outcomes:

By the end of the course, students will be able to:

1. Analyze and solve a wide range of mathematical problems involving real numbers, polynomials, equations, and inequalities.
2. Accurately represent and interpret functions graphically, and use them to model real-world situations.
3. Apply trigonometric functions and identities to solve a wide range of problems, including those involving angles, triangles, and periodic phenomena.
4. Apply geometric concepts, including congruence, similarity, and area/volume calculations, to real-world situations and practical problem-solving.
5. Apply derivatives to solve problems in diverse fields, showcasing an understanding of rates of change and optimization.
6. Analyze and sketch the graphs of functions, identify critical points, and determine local maxima and minima, showcasing proficiency in curve sketching and optimization techniques.
7. Grasp the concept of the Fundamental Theorem of Calculus and be able to apply it to evaluate definite integrals and solve related problems, showcasing a deep understanding of the relationship between differentiation and integration.

Topics and Learning Points	Teaching Hours
Unit 1: Algebra and Calculus	**8**
1.1 Real numbers and operations	
1.2 Polynomials and factoring	
1.3 Equations and Inequalities	
1.4 Exponents and Logarithms	
1.5 Basic functions and graphs	
1.6 Limits and Continuity	
Unit 2: Trigonometry and Geometry	**8**
2.1 Trigonometric functions and Identities	
2.2 Trigonometric equations	
2.3 Geometric figures and Relationships	
2.4 Congruence and similarity	
2.5 Area and Volume	
2.6 Coordinate Geometry	
Unit 3: Differential Calculus	**6**
3.1 Differentiation and its rules	
3.2 Applications of derivatives	
3.3 Curve sketching	
3.4 Maxima and minima	
Unit 4: Integral Calculus and basic Differential Equations	**8**
4.1 Integration and its techniques	
4.2 Applications of integrals	
4.3 Fundamental theorem of calculus	
4.4 Basic Differential Equations	

Text Book:

1. D. Somasundaram and B. Choudhary, A first course in Mathematical Analysis, Narosa.
   Unit 1 – Section 1.7 to 1.10 and 4.2 to 4.5
2. S. L. Loney, Plane Trigonometry, Cambridge University Press.
   Unit 2 – Sections V and IX.
3. Richard Rhoad, George Milauskas and Robert Whipple, Geometry for Enjoyment and Challenge, McDougal Littell.
   Unit 2 – Sections 3.1 to 3.3, 11.1 to 11.6, 12.4 to 12.6 and 13.1 to 13.3
4. James Stewart, Calculus with early Transcendental Functions, Cengage Learning, Indian Edition.
   Unit 3 – Sections 3.1 to 3.6 and 4.1, **Unit 4** – Sections 4.2, 4.3, 6.1 to 6.5 and 9.1

Reference Books:

1. James Stewart, Lothar Redlin and Saleem Watson, Precalculus: Mathematics for Calculus, Cengage Learning, Indian Edition.
2. S. L. Loney, Coordinate Geometry, Cambridge University Press.
3. Dennis G. Zill and Warren S. Wright, A first course in Differential Equations,
4. William E. Boyce and Richard C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Open Elective (OE)
Course Name : Basic Mathematics II
Course Code : MAT-166-OE
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Distinguish between rational and irrational numbers, and apply this knowledge to solve problems involving real numbers.
2. Demonstrate proficiency in using commutative, associative, and distributive properties to simplify expressions and solve equations.
3. Learn and apply different systems of measurement, developing the ability to convert between units and solve measurement-related problems.
4. Use properties of equality, such as addition, subtraction, multiplication, and division, to solve linear equations.
5. Develop proficiency in solving equations that contain variables and constants on both sides, demonstrating an understanding of balancing techniques.
6. Apply appropriate techniques to solve equations with coefficients represented as fractions or decimals, emphasizing precision in calculations.
7. Develop problem-solving strategies and apply them to real-world scenarios, including money applications and geometry problems involving angles, triangles, Pythagorean theorem, rectangles, triangles, trapezoids, circles, irregular figures, volume, surface area, and formula manipulation.

Course Outcomes:

By the end of the course, students will be able to:

1. Demonstrate a clear understanding of rational and irrational numbers, and apply them effectively in calculations. They will also exhibit proficiency in using properties like commutativity, associativity, and distributivity.
2. Develop expertise in solving linear equations using various properties of equality, including addition, subtraction, multiplication, and division. They will confidently handle equations with variables and constants on both sides, as well as those with fraction and decimal coefficients.
3. Successfully apply problem-solving strategies to a range of real-world scenarios. This includes solving money-related applications and using geometric properties like angles, triangles, Pythagorean theorem, rectangles, triangles, trapezoids, circles, irregular figures, volume, surface area, and formula manipulation.
4. Develop the ability to work with different systems of measurement, demonstrating proficiency in conversions and problem-solving related to measurements.
5. Exhibit proficiency in adding, subtracting, multiplying, and dividing polynomials. They will also apply exponentiation properties effectively, including multiplication properties of exponents and integer exponents with scientific notation.
6. Gain a foundational understanding of factoring polynomials, allowing them to further explore advanced concepts in algebraic manipulation.

Topics and Learning Points	Teaching Hours
Unit 1: The properties of Real Numbers	**8**
1.1 Rational and irrational numbers	
1.2 Commutative, associative and distributive properties	
1.3 Properties of identity, inverse and zero	
1.4 System of measurement	
Unit 2: Solving linear equations	**6**
2.1 Using the subtraction and addition properties of equality	
2.2 Using the division and multiplication properties of equality	
2.3 With variables and constants on both sides	
2.4 With fraction and decimal coefficients	
Unit 3: Math model and Geometry	**8**
3.1 Use a problem solving strategy	
3.2 Solve money applications	
3.3 Use properties of angles, triangles and the Pythagorean theorem	
3.4 Use properties of rectangles, triangles and trapezoids	
3.5 Solve geometry applications: Circles and irregular figures	
3.6 Solve geometry applications: Volume and surface area	
3.7 Solve a formula for a specific variable	
Unit 4: Polynomials	**8**
4.1 Add and subtract polynomials	
4.2 Use multiplication properties of exponents	
4.3 Multiply polynomials	
4.4 Divide monomials	
4.5 Integer exponents and scientific notation	
4.6 Introduction to factoring polynomials	

Text Book:

Lynn Marecek, Mary Anne Anthony-Smith, *Prealgebra,* openstax

Reference Books:

1. Bobson Wong, Larisa Bukalov and Steve Slavin, *A self-teaching guide: Practical Algebra, 3rd Edition,* Wiley Publication
2. Gary S. Goldman, *Prealgebra: A practical step by step approach, 4th Edition,* Pearblossom

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Open Elective (OE)
Course Name : Applied Mathematics II
Course Code : MAT-167-OE
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Develop the ability to accurately plot and interpret graphs of mathematical functions, understanding key concepts like slope, intercepts, and trends.
2. Apply the principles of rates, ratios, and proportions to solve practical problems in everyday situations, such as scaling recipes or calculating discounts.
3. Master the skills of collecting, organizing, and analyzing data, including the calculation of central measures like mean, median, and mode, as well as constructing basic visual representations.
4. Demonstrate a solid understanding of trigonometric ratios through hands-on activities and apply them to solve problems involving angles and triangles.
5. Calculate areas and perimeters of basic geometric shapes and employ these measurements to address practical problems in real-world scenarios.
6. Develop proficiency in calculating volumes and surface areas of simple 3D shapes and apply these measurements to solve practical problems.
7. Apply concepts of simple and compound interest to solve problems related to loans, investments, and financial transactions.
8. Cultivate logical thinking and problem-solving abilities through activities like coding exercises, logical puzzles, and games.

Course Outcomes:

By the end of the course, students will be able to:

1. Accurately plot and interpret graphs of functions, demonstrating an understanding of concepts like slope, intercepts, and trends.
2. Apply their knowledge of rates, ratios, and proportions to solve real-world problems, showcasing competence in situations like recipe scaling and discount calculations.
3. Demonstrate the ability to collect, organize, and analyze data, calculating measures like mean, median, and mode. They will also create visual representations like histograms and bar charts.
4. Apply basic trigonometric ratios to solve problems related to angles and triangles, showing proficiency in real-world applications.
5. Accurately calculate the areas, perimeters, volumes, and surface areas of various geometric shapes, demonstrating practical skills in solving related problems.
6. Apply their knowledge of simple and compound interest calculations, as well as programming concepts, to solve practical problems related to loans, investments, and basic coding tasks.

Topics and Learning Points

Teaching Hours

Theory: Introduction **12**

- Rate, ratio and proportion
- Trigonometric ratios
- Area, perimeters, volume and surface area
- Matrices and determinants

Practicals: **48**

1. Plotting and analyzing graphs of simple functions to understand concepts like slope, intercepts, and trends.
2. Rate, Ratio, and Proportion in Daily Life
3. Collecting and organizing data, calculating measures like mean, median, and mode, and creating simple histograms or bar charts.
4. Exploring trigonometric ratios through hands-on activities and applying them to solve problems related to angles and triangles.
5. Calculating areas and perimeters of simple shapes like squares, rectangles, and triangles, and using them to solve practical problems.
6. Volume and Surface Area of Solids
7. Simple and Compound Interest Calculations
8. Introducing students to simple programming concepts and logic through activities or platforms designed for beginners.
9. Logical Puzzles and Games
10. Introduction to Matrices and Determinants
11. Conducting experiments to understand probability distributions and their application in various scenarios.
12. Exploring basic principles of geometry as applied in engineering and architecture, such as designing structures or layouts.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Vocational Skill Course (VSC)
Course Name : GeoGebra Software
Course Code : MAT-171-VSC
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Familiarize students with the GeoGebra interface and basic tools.
2. Enable students to create and modify geometric constructions.
3. Introduce the concept of dynamic geometry and its applications.
4. Guide students in solving equations and inequalities using GeoGebra.
5. Introduce students to advanced algebraic operations like symbolic manipulation.
6. Introduce students to differentiation and its geometric interpretation in GeoGebra.
7. Guide students in understanding and visualizing integration concepts.
8. Demonstrate practical applications of calculus through dynamic models.
9. Encourage creativity and innovation in utilizing GeoGebra for problem-solving in STEM fields.

Course Outcomes:

By the end of the course, students will be able to:

1. Demonstrate proficiency in using the GeoGebra interface and basic tools, allowing them to navigate and utilize the software effectively.
2. Create and modify geometric constructions using GeoGebra, gaining proficiency in applying geometric principles within the software.
3. Understand and apply the concept of dynamic geometry, using GeoGebra to create interactive constructions that change in real-time based on manipulations.
4. Solve equations and inequalities using GeoGebra, gaining practical problem-solving skills within the software.
5. Learn and apply advanced algebraic operations, including symbolic manipulation, within GeoGebra to solve complex mathematical problems.
6. Gain an understanding of differentiation and its geometric interpretation in GeoGebra, allowing them to visualize and analyze functions' behavior.
7. Visualize and understand integration concepts within GeoGebra, enabling them to analyze and solve problems related to areas and accumulation.

Topics and Learning Points

	Teaching Hours
Unit 1: Introduction to GeoGebra	**8**
1.1 Covering the basic interface, tools, and functionalities.	
1.2 Create and manipulate geometric objects, input algebraic expressions.	
1.3 Explore the dynamic capabilities of GeoGebra.	
Unit 2: Exploring Algebraic Concepts	**8**
2.1 Explore algebraic concepts such as equations, functions, and inequalities.	
2.2 Learn how to graph functions and solve equations.	
2.3 Perform algebraic operations within GeoGebra.	
Unit 3: Analyzing Calculus Concepts	**8**
3.1 Visualize and explore limits and continuity.	
3.2 Visualize and explore differentiation.	
3.3 Visualize and explore integration.	
Unit 4: Applications in STEM Fields	**6**
4.1 Applications in Statistics	
4.2 Applications in Physics	
4.3 Applications in Engineering	

Text Book:

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2023 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Skill Enhancement Course (SEC)
Course Name : Scilab and Maxima Software II
Course Code : MAT-176-SEC
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Develop proficiency in performing basic algebraic operations, including solving systems of linear equations, expanding and simplifying polynomials, factorizing quadratic equations, and manipulating matrices using Maxima as well as Scilab.
2. Gain proficiency in using Maxima as well as Scilab for symbolic calculus operations, including finding derivatives and evaluating both definite and indefinite integrals of various functions.
3. Acquire the skill to solve first-order and second-order differential equations, both ordinary and partial, using Maxima as well as Scilab.
4. Explore and utilize Scilab's capabilities for trigonometric function evaluation and manipulation.
5. Learn how to plot and visualize mathematical functions, including creating plots of functions along with their derivatives and generating 3D plots of surfaces defined by mathematical expressions.
6. Apply the knowledge gained through practical exercises using Maxima as well as Scilab to solve real-world mathematical problems across various domains, reinforcing the practical applicability of Maxima in mathematical computations.

Course Outcomes:

By the end of the course, students will be able to:

1. Demonstrate proficiency in performing fundamental algebraic operations, including solving systems of linear equations, expanding and simplifying polynomials, factorizing quadratic equations, and manipulating matrices using both Maxima and Scilab.
2. Master the use of Maxima and Scilab for symbolic calculus operations. This includes finding derivatives and evaluating both definite and indefinite integrals of various functions with precision and accuracy.
3. Acquire the ability to solve a wide range of differential equations, including first-order and second-order equations, both ordinary and partial, using Maxima and Scilab.
4. Explore and utilize Scilab's capabilities for the evaluation and manipulation of trigonometric functions, enabling them to solve complex mathematical problems involving trigonometric expressions.
5. Develop proficiency in visualizing mathematical functions. They will be able to create plots of functions, including their derivatives, and generate 3D plots of surfaces defined by mathematical expressions using Maxima and Scilab.
6. Apply the knowledge gained through practical exercises using both Maxima and Scilab to solve real-world mathematical problems across various domains. This reinforces the practical applicability of these tools in a wide range of mathematical computations.

Topics and Learning Points

Teaching Hours

Theory: Maxima and Scilab softwares **12**

1. Polynomials
2. Quadratic equations
3. Limit, derivatives and integrations
4. First order differential equations

Practicals: **48**

1. Expand and simplify a polynomial expression in maxima.
2. Factorize a quadratic equation in maxima.
3. Find the derivative of a given function symbolically using maxima.
4. Evaluate definite and indefinite integrals using maxima.
5. Find the limits of functions as they approach a specific value or infinity using maxima.
6. Solve a first-order differential equation using maxima.
7. Expand and simplify a polynomial expression in Scilab.
8. Factorize a quadratic equation in Scilab.
9. Find the derivative of a given function symbolically using Scilab.
10. Evaluate definite and indefinite integrals using Scilab.
11. Find the limits of functions as they approach a specific value or infinity using Scilab.
12. Solve a first-order differential equation using Scilab.

Reference Books:

1. Edwin L. Woollett, *Maxima by example: A step by step introduction to computer algebra using Maxima*
2. Tejas Sheth, Satish Annigeri and Rajesh Jakhotia, *Scilab: A practical introduction to programming and problem solving.*

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II) **Subject:** Mathematics
Course: Geometry **Course Code:** MAT-151-MJM
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2							1
CO 2	3	2							
CO 3	2	3			1				1
CO 4	3	2							
CO 5	3	2							
CO 6	3	3				1		1	
CO 7	3	2		1	2				1

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Student will demonstrate proficiency in performing translations and rotations of coordinate axes.
CO2: Student will be able to determine the nature of conic and reduce its equation to standard form.
CO3: Student will be able to use three-dimensional Cartesian coordinate system in different scenarios.
CO4: Student will be able to calculate direction cosines and angle between lines using coordinate geometry techniques.
CO5: Student will be able to understand difference between coplanar and skew lines.
CO6: Student will understand intersection of sphere with line, plane and sphere.
CO7: Student will apply the equation of tangent plane to a sphere, illustrating a high-level proficiency in this advanced geometric concept.

PO2: Critical Thinking and Problem Solving
CO1: Student will apply their knowledge of coordinate geometry to solve problems involving the translation and rotation of geometric figures.
CO2: Student will apply their knowledge of conic section to solve problems involving the manipulation of geometric figures.
CO3: Student will be able to use three-dimensional Cartesian coordinate system in different scenarios.
CO4: Student will apply the calculation of direction cosines and angles between lines in coordinate geometry to enhance their critical thinking and problem-solving skills by understanding spatial relationships and solving geometric problems in three-dimensional space.
CO5: Mastering spatial reasoning in three dimensions enhances a student's capacity to analyze intricate geometric relationships, crucial for solving real-world problems across diverse fields.

CO6: Exploring plane sections of spheres sharpens critical thinking through in-depth analysis of intricate three-dimensional relationships, honing spatial reasoning and mathematical problem-solving skills.
CO7: Proficiency in tangent plane equations for spheres sharpens critical thinking and problem-solving, illuminating local behavior and spatial relationships in environmental contexts.

PO4: Research-related skills and Scientific temper
CO7: Proficiency in spherical geometry empowers student to analyze Earth's curvature, navigate celestial objects, and process geospatial data, enhancing their scientific acumen in three-dimensional studies.

PO5: Trans-disciplinary Knowledge
CO3: Student will use three-dimensional Cartesian geometry to analyze and model complex physical phenomena in fields like physics, engineering, and computer science, enabling them to solve real-world problems involving spatial relationships and dimensions.
CO7: Proficiency in spherical geometry empowers student to navigate and analyze complex spatial phenomena in diverse fields like physics, astronomy, geography, and geology.

PO6: Personal and Professional Competence
CO6: Spherical geometry enriches competence with spatial reasoning, problem-solving, and a 3D perspective, vital in astronomy, navigation, and computer graphics.

PO8: Environment and Sustainability
CO6: Proficiency in spherical geometry enhances comprehension and analysis of global environmental phenomena, enabling accurate measurements and precise modeling for sustainable solutions.

PO9: Self-directed and Life-long Learning
CO1: Analytical geometry in two dimensions cultivates spatial reasoning for independent problem-solving across diverse fields, promoting lifelong learning.
CO3: Proficiency in three-dimensional Cartesian coordinates empowers student with a crucial spatial analysis toolset, fostering lifelong learning and enabling precise problem-solving in real-world contexts.
CO7: Studying spherical geometry fosters a broader understanding of spatial relationships, enhancing self-directed and life-long learning by providing a unique perspective on non-Euclidean geometries and applications in fields like astronomy and navigation.

Choice Based Credit System Syllabus (2023 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: F.Y.B.Sc. (Sem II) **Subject:** Mathematics

Course: Calculus & Differential Equation **Course Code:** MAT-152-MJM

Weightage: 1=weak or low relation, 2=moderate or partial relation, 3= strong or direct relation.

	Programme Outcomes(POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2							
CO 2	3	2							
CO 3	3	2							
CO 4		2							
CO 5	3			2					
CO 6	3	2							
CO 7				2	2	2			2

Justification for the mapping

PO 1: Disciplinary Knowledge:

CO1:Students will apply derivative of one variable functions in various fields .

CO2:Students will recognize behaviour of increasing decreasing functions using Mean Value theorems.

CO3: Students will able study function of one variable using derivative.

CO5:Students will develop deep understanding of integration and use it to solve real world problems.

CO6:Students will apply their understanding of dependent and independent variables in view of differential equation in various fields such as physics,chemistry,biology and engineering.

PO2:Critical Thinking and Problem Solving:

CO1:Students will apply their knowledge of derivative to find orthogonal trajectory, critical points of a function etc.

CO2:Students will use knowledge of Mean Value theorems to solve problems related to accuracy.

CO3:Students will able to understand nature of any function of one variable and apply to solve real world problems.

CO4: Students will use their knowledge of integration to solve problems involving area.

CO6: Students will able to think about dependent and independent variable and their relation in different fields.

PO4: Research-related skills and Scientific temper:

CO5:Students will able to find to find graphical net area using integration.

CO7:Students will able to apply the tools of calculus and differential equations to various real world problems in different areas.

PO5:Trans-disciplinary Knowledge:

CO7:Students will apply mathematical concept such as Mean Value Theorem, Series, Integration, orthogonal trajectory and solving differential equation to solve complex problems. These concepts are useful in many different fields such as Physics,engineering ,chemistry and economics.

PO6:Personal and professional competence:

CO7:Students will able to demonstrate the ability to apply mathematical concept such as derivative, integration in practical manner. This ability is essential for personal and professional development.

PO9:Self-directed and Life-long learning:

CO7: Students will demonstrate the ability to apply the concept of calculus and differential equations in practical context. This ability will enable them to continue learning and developing skills throughout life.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II) **Subject**: Mathematics
Course: Mathematics Practical II **Course Code**: MAT-153-MJM
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	2							
CO 2	3	2							
CO 3	3	2							
CO 4	3	2							
CO 5					2				
CO 6						2			2

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Students will demonstrate proficiency in translating and rotating coordinate axes, converting equations of conic sections into standard forms, and manipulating these equations.
CO2: Students will develop a deep understanding of planes and systems of planes, enabling them to solve complex spatial problems.
CO3: Students will master the formulation of line equations in both symmetric and asymmetric forms, and be able to identify and analyze coplanar lines.
CO4: Students will develop competence in analyzing various aspects of spheres, including plane sections, intersections of two spheres, and intersections of a sphere with a line.

PO2: Critical Thinking and Problem Solving
CO1: Students will apply their knowledge of coordinate geometry and conic sections to solve problems involving the translation, rotation, and manipulation of geometric figures.
CO2: Students will use their understanding of planes and systems of planes to solve complex spatial problems, such as finding the equation of a plane containing three given points or finding the intersection of two planes.
CO3: Students will apply their knowledge of line equations to solve problems involving the intersection of lines and planes, as well as the properties of coplanar lines.
CO4: Students will use their understanding of spheres to solve problems involving plane sections, intersections of two spheres, and intersections of a sphere with a line.

PO5: Trans-disciplinary Knowledge
CO5: Students will apply mathematical concepts, such as the Mean Value Theorem, L'Hôpital's Rule, Taylor's series, Riemann integration, and solving differential equations, to solve a variety of analytical problems. These concepts are used in many different disciplines, such as physics, engineering, and economics.

PO6: Personal and Professional Competence
CO6: Students will demonstrate the ability to apply mathematical concepts and techniques, such as finding orthogonal trajectories, in practical contexts across various disciplines. This ability is essential for success in many different careers.

PO9: Self-directed and Life-long Learning
CO6: Students will demonstrate the ability to apply mathematical concepts and techniques in practical contexts. This ability will enable them to continue learning and developing their skills throughout their careers.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II) **Subject:** Mathematics
Course: Fundamentals of Mathematics **Course Code:** MAT-161-MN
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3	3		1	2				
CO 2	3	3			2				1
CO 3	3	2			1				1
CO 4	3	3			2				1
CO 5	3	2		1	2			1	
CO 6	3	2		1	1				
CO 7	3	3			1				

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Student will develop analytical skills to solve diverse mathematical problems by applying concepts related to real numbers, polynomials, equations, and inequalities within their disciplinary knowledge.

CO2: Student will represent and interpret functions graphically to develop a visual understanding of mathematical relationships and apply them to analyze and solve real-world problems in various disciplines.

CO3: Student will apply trigonometric functions and identities to analyze and model real-world phenomena, enabling them to understand angles, triangles, and periodic behavior in various disciplines, from engineering to physics and even music theory.

CO4: Student will apply geometric concepts to real-world situations and practical problem-solving in Disciplinary Knowledge to analyze and design structures, plan urban layouts, and optimize spatial arrangements in various fields.

CO5: Student will apply derivatives to analyze and optimize processes in fields such as economics, physics, engineering, and biology, demonstrating a profound grasp of rates of change and optimization principles within their respective disciplines.

CO6: Student will develop the ability to visually represent and analyze functions, pinpointing critical points and discerning local extrema, demonstrating expertise in both curve sketching and optimization methodologies within the discipline.

CO7: Understanding the Fundamental Theorem of Calculus bridges the gap between differentiation and integration, empowering student to tackle intricate problems and demonstrate deep proficiency in calculus.

PO2: Critical Thinking and Problem Solving

CO1: Student will develop critical thinking and problem-solving skills by applying mathematical concepts to analyze and solve diverse problems, including those involving real numbers, polynomials, equations, and inequalities.

CO2: Graphical representation of functions enables student to visually analyze relationships, make informed decisions, and effectively model real-world scenarios, fostering critical thinking and problem-solving skills.
CO3: By applying trigonometric functions and identities, student develop the analytical skills necessary to tackle diverse problems involving angles, triangles, and periodic phenomena, fostering critical thinking and problem-solving abilities.
CO4: Applying geometry to real-world scenarios hones critical thinking and problem-solving skills, vital for diverse fields and everyday decision-making.
CO5: By mastering derivatives, student gain the analytical tools to quantify rates of change and optimize outcomes across disciplines, fostering critical thinking and problem-solving skills essential for real-world applications.
CO6: Analyzing and sketching graphs of functions equips student with the essential skill of applying critical thinking and problem-solving techniques to identify critical points and determine local maxima and minima, showcasing proficiency in curve sketching and optimization.
CO7: Mastering the Fundamental Theorem of Calculus enhances students' ability to seamlessly integrate differentiation and integration, leading to proficient evaluation of definite integrals and refined problem-solving skills.

PO4: Research-related skills and Scientific temper
CO1: Developing proficiency in mathematical analysis cultivates research-related skills and a scientific temper, enabling students to effectively tackle a diverse array of problems involving real numbers, polynomials, equations, and inequalities.
CO5: Student will apply derivatives to analyze and optimize processes in various scientific disciplines, demonstrating proficiency in understanding rates of change and fostering a research-oriented mindset for tackling complex problems.
CO6: Proficiency in graph analysis and optimization techniques equips student with essential research skills for modeling and understanding complex real-world phenomena.

PO5: Trans-disciplinary Knowledge
CO1: Analyzing and solving mathematical problems in trans-disciplinary knowledge cultivates critical thinking and problem-solving skills essential for addressing complex real-world issues across various fields.
CO2: Proficient graphical function representation fosters a comprehensive understanding and application across diverse fields, enabling student to model real-world scenarios effectively.
CO3: Proficiency in trigonometric functions and identities broadens problem-solving capabilities across disciplines, from geometry and physics to engineering and music theory.
CO4: Student will apply geometric concepts to solve real-world problems by understanding the relationships between shapes, sizes, and dimensions in diverse fields, fostering trans-disciplinary knowledge.
CO5: Student will apply derivatives to analyze and optimize processes in fields ranging from economics and engineering to biology and physics, demonstrating a profound grasp of rates of change and optimization across diverse disciplines.
CO6: Student will develop a comprehensive understanding of function behavior, critical points, and optimization, showcasing mastery in both curve sketching and trans-disciplinary applications.
CO7: Mastering the Fundamental Theorem of Calculus enables student to unify accumulation and rate of change, offering a profound insight into their interconnectedness across diverse disciplines.

PO8: Environment and Sustainability

CO5: Proficiency in applying derivatives empowers student to model and optimize environmental processes, fostering informed decisions for sustainable resource allocation and ecosystem management.

PO9: Self-directed and Life-long Learning

CO2: Developing proficiency in graphically representing and interpreting functions empowers student to autonomously apply mathematical concepts to model and solve real-world problems throughout their lifelong learning journey.

CO3: Mastering trigonometric functions and identities empowers student to independently tackle diverse problems related to angles, triangles, and periodic phenomena throughout their lifelong learning journey.

CO4: Student will apply geometric concepts in self-directed and life-long learning to solve real-world problems by understanding and manipulating spatial relationships, enabling them to make informed decisions in various practical situations.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: First Year (Sem II) **Subject:** Mathematics
Course: Basic Mathematics II **Course Code:** MAT-166-OE
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	2			1				
CO 2	2	2		1	2			1	
CO 3	2	1			2				1
CO 4	2	2			1			1	1
CO 5	2	2			2				
CO 6	2	2		1	1				

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Student will demonstrate a clear understanding of rational and irrational numbers and apply them effectively in calculations, exhibiting proficiency in utilizing properties like commutativity, associativity, and distributivity, thereby enhancing their disciplinary knowledge in mathematics.
CO2: Student will develop expertise in solving linear equations using various properties of equality, enabling them to confidently handle equations with diverse variable and constant arrangements, including fractions and decimal coefficients, within the discipline of Mathematics.
CO3: Student will successfully apply problem-solving strategies by mastering a diverse array of mathematical concepts, from money-related applications to geometric properties, enabling them to navigate and excel in various real-world scenarios.
CO4: Studying measurements equips student with the essential skill of seamlessly navigating various systems of measurement, demonstrating adeptness in conversions and problem-solving within their respective disciplines.
CO5: Student will demonstrate proficiency in polynomial operations and exponentiation properties, showcasing their ability to apply mathematical concepts effectively in disciplinary knowledge.
CO6: Mastering factoring polynomials provides student with a solid foundation for delving into advanced algebraic manipulation, enabling them to tackle more complex mathematical concepts with confidence and proficiency.

PO2: Critical Thinking and Problem Solving
CO1: By effectively applying properties like commutativity, associativity, and distributivity, student will demonstrate a clear understanding of rational and irrational numbers, showcasing proficiency in critical thinking and problem solving.

CO2: Student will develop expertise in solving linear equations by mastering the properties of equality, enabling them to confidently navigate equations with diverse variables, constants, fractions, and decimals, fostering critical thinking and problem-solving skills.
CO3: Student will apply problem-solving strategies by integrating mathematical concepts and geometric properties into critical thinking, enabling them to tackle diverse real-world scenarios, including those involving financial calculations and geometric applications.
CO4: Studying different systems of measurement enhances critical thinking and problem-solving skills by fostering proficiency in conversions, enabling student to navigate diverse measurement contexts effectively.
CO5: Student will exhibit proficiency in polynomial operations and exponentiation properties through rigorous practice and application in critical thinking scenarios, demonstrating a deep understanding of mathematical concepts.
CO6: Mastering polynomial factoring provides student with a solid foundation for tackling advanced algebraic concepts, fostering critical thinking and problem-solving skills essential for higher-level mathematics.

PO4: Research-related skills and Scientific temper
CO2: Developing expertise in solving linear equations fosters research-related skills and scientific temper by promoting precision and logical reasoning in mathematical problem-solving.
CO6: Mastering factoring polynomials provides a solid foundation for tackling advanced algebraic manipulations, essential for conducting rigorous research and fostering a scientific mindset.

PO5: Trans-disciplinary Knowledge
CO1: Student will showcase mastery in differentiating rational and irrational numbers, demonstrating their adeptness in employing mathematical properties such as commutativity, associativity, and distributivity across various disciplines for effective problem-solving.
CO2: Student will develop expertise in solving linear equations through hands-on practice and application, mastering properties of equality for diverse equation types, including fractions and decimals, within a comprehensive, trans-disciplinary framework.
CO3: Through hands-on application and trans-disciplinary knowledge, student will adeptly apply problem-solving strategies, utilizing geometric properties and financial concepts, to navigate diverse real-world scenarios.
CO4: Developing measurement proficiency enhances students' adaptability across diverse fields, fostering trans-disciplinary problem-solving and collaboration.
CO5: The student will demonstrate mastery in polynomial operations and exponentiation, showcasing an ability to apply them effectively across various disciplines.
CO6: Mastering polynomial factoring forms the cornerstone for delving into advanced algebraic techniques, enabling seamless exploration of trans-disciplinary applications across various fields.

PO8: Environment and Sustainability
CO2: Mastering linear equations cultivates analytical skills crucial for addressing environmental and sustainability challenges through precise mathematical modeling.
CO4: Studying different measurement systems fosters adaptability and enhances problem-solving skills crucial for effective environmental and sustainability practices.

PO9: Self-directed and Life-long Learning
CO3: By mastering problem-solving techniques in mathematics, student develop a versatile skill set crucial for confidently navigating various real-world situations, from financial decision-making to applying geometric principles, fostering self-directed and life-long learning.

CO4: Developing measurement proficiency fosters self-directed learning by enabling student to navigate diverse systems and solve real-world measurement challenges autonomously.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: First Year (Sem II) **Subject:** Mathematics
Course: Applied Mathematics II **Course Code:** MAT-167-OE
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	3		1	2				
CO 2	2	3			2				
CO 3	2	2		2	1	1		2	
CO 4	2	3			2				
CO 5	2	2			2				
CO 6	2	3			1				2

Justification for the mapping

PO1: Disciplinary Knowledge
CO1: Student will accurately plot and interpret graphs by grasping the fundamental concepts of slope, intercepts, and trends within their disciplinary knowledge.
CO2: Student will apply rates, ratios, and proportions to accurately scale recipes and calculate discounts, demonstrating proficiency in practical applications of mathematical concepts within disciplinary knowledge.
CO3: The student will showcase proficiency in data collection, organization, and analysis, including computation of central measures and creation of visual representations within their disciplinary knowledge.
CO4: Student apply basic trigonometric ratios to solve real-world problems involving angles and triangles, demonstrating proficiency in disciplinary knowledge by analyzing and modeling various scenarios.
CO5: Student will accurately calculate geometric properties through rigorous practice and application of mathematical concepts in real-world problem-solving.
CO6: Student will apply their knowledge to analyze financial scenarios, develop algorithms for interest calculations, and implement them in code for effective management of loans, investments, and basic programming tasks.

PO2: Critical Thinking and Problem Solving
CO1: Accurate graph plotting demonstrates a deep grasp of mathematical concepts, allowing student to analyze and interpret data effectively, fostering critical thinking and problem-solving skills.
CO2: Student will apply rates, ratios, and proportions to critically analyze and adjust quantities in scenarios like recipe scaling and discount calculations, demonstrating proficiency in practical problem-solving.

CO3: Student will showcase data proficiency through hands-on application, employing statistical measures and visualizations for robust critical thinking and problem-solving.
CO4: By mastering basic trigonometric ratios, student develop critical thinking and problem-solving skills essential for tackling real-world applications involving angles and triangles.
CO5: Student will accurately calculate geometric properties by applying critical thinking and problem-solving skills through practice and understanding of mathematical concepts.
CO6: Student will apply their knowledge of simple and compound interest to make informed financial decisions and leverage programming concepts to create automated tools for loan and investment analysis, enhancing their problem-solving skills.

PO4: Research-related skills and Scientific temper
CO1: Accurate graph plotting showcases a student's adeptness in interpreting functions, including key concepts like slope, intercepts, and trends, reflecting strong research skills and a scientific mindset.
CO3: Student will showcase proficiency in data handling, employing statistical measures and visualizations for comprehensive research-driven insights.

PO5: Trans-disciplinary Knowledge
CO1: Develops analytical skills through hands-on application, enabling precise graph plotting, interpretation, and recognition of key mathematical concepts such as slope, intercepts, and trends across diverse disciplines.
CO2: Student will apply rates, ratios, and proportions to scale recipes and calculate discounts, demonstrating proficiency in practical, trans-disciplinary contexts.
CO3: The student will showcase proficiency in data handling, including calculation of measures and creation of visual representations, demonstrating trans-disciplinary knowledge.
CO4: Student apply trigonometric ratios to solve real-world problems involving angles and triangles, demonstrating proficiency in cross-disciplinary applications through practical problem-solving skills.
CO5: Student will accurately calculate geometric properties through hands-on problem-solving, promoting trans-disciplinary skills.
CO6: Student will apply their knowledge to develop algorithms for financial calculations, enabling them to make informed decisions about loans, investments, and write efficient code for automated financial tasks.

PO6: Personal and professional competence
CO3: Student will showcase proficiency in data collection, organization, and analysis, employing statistical measures and visualizations to enhance personal and professional competence.

PO8: Environment and Sustainability
CO3: Student will showcase proficiency in data collection, organization, and analysis, including calculating key measures (mean, median, mode) and creating impactful visualizations (histograms, bar charts) to address issues in Environment and Sustainability.

PO9: Self-directed and Life-long Learning
CO6: Student will apply their knowledge of interest calculations and programming concepts to make informed financial decisions, optimize investments, and automate basic financial tasks, enhancing their self-directed and life-long learning capabilities.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II) **Subject:** Mathematics
Course: GeoGebra Software **Course Code:** MAT-171-VSC
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	3			1				
CO 2	2	3			1	1			1
CO 3	3	3		1	2				
CO 4	2	2			1			1	
CO 5	2	3		1	2				
CO 6	2	3			2				
CO 7	3	2			1				

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Proficiency in GeoGebra enables student to seamlessly apply mathematical concepts and explore geometric relationships, enhancing their disciplinary knowledge and problem-solving skills.

CO2: Student will develop expertise in applying geometric principles through hands-on experience with GeoGebra, enabling them to create and manipulate geometric constructions effectively.

CO3: Utilizing GeoGebra for dynamic geometry enables student to actively engage with disciplinary knowledge, fostering a deeper understanding through hands-on exploration and immediate visual feedback.

CO4: Student will solve equations and inequalities using GeoGebra to gain practical problem-solving skills within the software, enhancing their disciplinary knowledge through hands-on application.

CO5: Student will use advanced algebraic operations and symbolic manipulation in GeoGebra to analyze and solve intricate mathematical problems, enhancing their proficiency in disciplinary knowledge.

CO6: Student will gain a profound understanding of differentiation and its geometric interpretation in GeoGebra, enabling them to visualize and analyze functions' behavior, thus enhancing their proficiency in disciplinary knowledge.

CO7: Using GeoGebra for integration concepts allows student to visualize, manipulate, and interact with mathematical functions and geometric shapes, fostering a deeper understanding of the principles underlying areas and accumulation in disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO1: Student will demonstrate proficiency in using the GeoGebra interface and basic tools, enabling effective software utilization for critical thinking and problem solving by creating, manipulating, and analyzing mathematical models.

CO2: Student will develop critical thinking and problem-solving skills by creating and modifying geometric constructions in GeoGebra, as it requires them to apply geometric principles to solve real-world problems and challenges within the software.

CO3: Using GeoGebra, student can actively engage with dynamic geometry, honing critical thinking and problem-solving skills as they create and manipulate interactive constructions in real-time, fostering a deeper understanding of geometric concepts.

CO4: Using GeoGebra, student can visually manipulate mathematical concepts, fostering critical thinking and problem-solving skills through hands-on experience with equations and inequalities in a dynamic digital environment.

CO5: Student will apply advanced algebraic operations in GeoGebra to enhance critical thinking and problem-solving by gaining a deeper understanding of mathematical relationships and efficiently manipulating symbols to solve complex problems.

CO6: Utilizing GeoGebra for differentiation provides student with a dynamic visual platform to grasp the geometric interpretation, enabling them to effectively analyze functions and cultivate critical thinking skills in problem-solving scenarios.

CO7: Using GeoGebra for integration concepts enhances students' critical thinking and problem-solving skills by providing a dynamic visual platform to explore, visualize, and manipulate mathematical relationships, enabling them to gain a deeper understanding of how integration relates to areas and accumulation.

PO4: Research-related skills and Scientific temper

CO3: Student will apply dynamic geometry through GeoGebra to develop interactive constructions, honing their research-related skills and fostering a scientific temper by exploring mathematical concepts in real-time.

CO5: Student will apply advanced algebraic operations in GeoGebra to enhance their research-related skills and develop a scientific temper by effectively utilizing symbolic manipulation to analyze and solve complex mathematical problems.

PO5: Trans-disciplinary Knowledge

CO1: "Proficiency in GeoGebra enables student to seamlessly integrate mathematical concepts with other disciplines, fostering a trans-disciplinary approach to problem-solving and knowledge application.

CO2: Student will develop the ability to apply geometric principles effectively through hands-on experience with GeoGebra, enhancing their trans-disciplinary knowledge and problem-solving skills.

CO3: Using GeoGebra to create interactive constructions fosters a deeper understanding of dynamic geometry by allowing student to actively manipulate figures and observe real-time changes, thereby enhancing trans-disciplinary knowledge application.

CO4: Using GeoGebra for equation solving cultivates trans-disciplinary knowledge by enabling student to seamlessly apply mathematical concepts in real-world scenarios, enhancing their problem-solving proficiency within the software.

CO5: Student will apply advanced algebraic operations in GeoGebra to effectively model and analyze real-world phenomena, fostering trans-disciplinary understanding and problem-solving skills.

CO6: Utilizing GeoGebra enables student to grasp the concept of differentiation and its geometric representation, facilitating a visual and analytical approach to comprehending functions' behavior across various disciplines.
CO7: Using GeoGebra for integration concepts provides visual and interactive representations, fostering intuitive understanding and enabling students to effectively analyze and solve problems related to areas and accumulation across disciplines.

PO6: Personal and professional competence
CO2: Using GeoGebra, student will develop expertise in creating and manipulating geometric constructions, honing their ability to apply essential geometric principles for both personal and professional competency.

PO8: Environment and Sustainability
CO4: Using GeoGebra, student can visually model and solve equations and inequalities related to Environment and Sustainability, fostering practical problem-solving skills through hands-on exploration and analysis of real-world scenarios.

PO9: Self-directed and Life-long Learning
CO2: Using GeoGebra, student develop self-directed and life-long learning skills by creating and modifying geometric constructions, honing their proficiency in applying fundamental geometric principles within the software.

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

Mapping of Program Outcomes with Course Outcomes

Class: FYBSc (Sem II) **Subject:** Mathematics
Course: Scilab and Maxima Software II **Course Code:** MAT-176-SEC
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	2	1			1				
CO 2	1	2							
CO 3	2	2			1				
CO 4	2	2							
CO 5	2	2							
CO 6	1	1			1				

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Student will demonstrate proficiency in fundamental algebraic operations, utilizing Maxima and Scilab, to effectively solve systems of linear equations, expand and simplify polynomials, factorize quadratic equations, and manipulate matrices within their disciplinary knowledge.

CO2: Student will master the use of Maxima and Scilab for symbolic calculus operations through comprehensive practice and application, enabling them to find derivatives and evaluate definite and indefinite integrals with precision and accuracy in their respective disciplinary knowledge areas.

CO3: Learning to solve a wide range of differential equations using Maxima and Scilab enhances a student's disciplinary knowledge by providing them with powerful computational tools and analytical skills crucial for addressing diverse real-world problems in various fields.

CO4: Student will harness Scilab's powerful tools to efficiently analyze and manipulate trigonometric functions, enhancing their ability to tackle intricate mathematical problems within the realm of disciplinary knowledge.

CO5: Student will develop proficiency in visualizing mathematical functions through hands-on experience in creating plots and generating 3D surfaces using Maxima and Scilab, enhancing their understanding of mathematical expressions in disciplinary knowledge.

CO6: By engaging in practical exercises with Maxima and Scilab, student acquire the proficiency to tackle real-world mathematical challenges spanning diverse domains, affirming the tools' versatile application in disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO1: Students will demonstrate proficiency in algebraic operations through hands-on application in Maxima and Scilab, showcasing their critical thinking and problem-solving abilities.

CO2: Mastering Maxima and Scilab empowers student with the critical thinking and problem-solving skills needed to proficiently perform symbolic calculus operations, ensuring precise and accurate computation of derivatives and both definite and indefinite integrals across a wide range of functions.

CO3: Student will acquire the ability to solve a wide range of differential equations, fostering critical thinking and problem-solving skills, by utilizing Maxima and Scilab as powerful computational tools to apply theoretical concepts to real-world scenarios.

CO4: Utilizing Scilab for trigonometric functions empowers student to tackle complex mathematical problems, fostering critical thinking and problem-solving skills through hands-on exploration and application.

CO5: Student will develop proficiency in visualizing mathematical functions through hands-on experience with Maxima and Scilab, enabling them to create plots of functions, including derivatives, and generate 3D plots of surfaces, enhancing their critical thinking and problem-solving skills.

CO6: Student will apply the knowledge gained through practical exercises using both Maxima and Scilab to solve real-world mathematical problems across various domains, fostering critical thinking and problem-solving skills by demonstrating the practical applicability of these tools in a wide range of mathematical computations.

PO5: Trans-disciplinary Knowledge

CO1: Demonstrating proficiency in fundamental algebraic operations, including system solving, polynomial manipulation, quadratic equation factorization, and matrix manipulation using Maxima and Scilab fosters essential problem-solving skills applicable across various academic disciplines.

CO3: Utilizing Maxima and Scilab equips student with the proficiency to tackle diverse sets of differential equations, spanning first and second-order, ordinary and partial, fostering trans-disciplinary problem-solving skills.

CO6: Student will apply Maxima and Scilab to solve real-world mathematical problems, showcasing the tools' versatility and practical relevance across diverse domains, reinforcing trans-disciplinary knowledge.