Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

(Autonomous)

Three/Four Year Honours/Honours with Research B.Sc. Degree Program in Mathematics (Faculty of Science)

CBCS Syllabus

FYBSc (Mathematics)

For Department of Mathematics

NEP-2.0

Choice Based Credit System Syllabus

(2024 Pattern)

(As Per NEP-2020)

To be implemented from Academic Year 2024-2025

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 13th March, 2024 and Circular of SPPU, Pune dated 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.

Level/ Difficulty	Sem	Subject DSC-1	Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)	2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	**22**
	II	2(T)+2(P)	2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T	**22**
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.											

Level/ Difficulty	Sem	Credits Related to Major				Minor	--	GE/OE	SEC	IKS	AEC	VEC	CC	Total
		Major Core	Major Elective	VSC	FP/OJT/CEP/RP									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	**22**
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	**22**
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	**22**
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	**22**
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	**22**
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	**22**
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

T = Theory **P** = Practical **DSC** = Discipline Specific Course **OE** = Open Elective **SEC** = Skill Enhancement Course
IKS = Indian Knowledge System **AEC** = Ability Enhancement Course **VEC** = Value Education Course **CC** = Co-curricular Course
VSC= Vocational Skill Course **OJT**= On Job Training **CEP**= Community Engagement Project **FP**= Field Project **RP**= Research Project

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati (Autonomous)

NEP-2.0

Course Structure for F.Y.B.Sc. (2024 Pattern as per NEP-2020)

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
	DSC-I (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	MAT-101-GEN	Algebra and Calculus	T	02
		MAT-102-GEN	Algebra and Calculus Practical with Python	P	02
	Open Elective (OE)	MAT-103-OE	Basic Mathematics	T	02
	Skill Enhancement Course (SEC)	MAT-104-SEC	Scilab Software	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC		T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS		T	02
				Total Credits Semester-I	**22**
II	DSC-I (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	MAT-151-GEN	Geometry and Differential Calculus	T	02
		MAT-152-GEN	Geometry and Differential Calculus Practical with Geogebra	P	02
	Open Elective (OE)	MAT -153-OE	Applied Mathematics	T	02
	Skill Enhancement Course (SEC)	MAT -154-SEC	Maxima Software	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC		T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	T	02
				Total Credits Semester-II	**22**
				Cumulative Credits Semester I + Semester II	**44**

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.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : I
Course Type : Theory
Course Name : Algebra and Calculus
Course Code : MAT-101-GEN
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Gain a solid foundation in set theory, including basic operations and their applications in various mathematical contexts.
2. Develop the ability to analyze different types of relations and functions, understand their properties, and apply them to solve mathematical problems.
3. Use the well-ordering principle and mathematical induction to establish proofs and understand the principles of divisibility, including the use of algorithms for finding greatest common divisors.
4. Acquire knowledge of the fundamental theorem of arithmetic and the basic properties of congruences to solve problems in number theory.
5. Learn to perform arithmetic operations with complex numbers, understand their properties, and represent them in exponential form.
6. Explore the algebraic and order properties of real numbers and understand the significance of absolute value and its geometric interpretation on the real line.
7. Understand the definitions and properties of sequences and limits, apply various limit theorems, and extend the concept of limits to functions, enhancing problem-solving skills in calculus.

Course Outcomes:

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

CO1: Demonstrate proficiency in basic set operations and utilize sets in mathematical proofs and problem-solving.

CO2: Identify and work with different types of relations and functions, understand equivalence relations, and perform composition and inversion of functions.

CO3: Apply the principles of mathematical induction, the division algorithm, and the Euclidean algorithm to solve problems related to divisibility and greatest common divisors.

CO4: Understand and apply the fundamental theorem of arithmetic and properties of congruences in solving integer-related problems.

CO5: Execute operations involving complex numbers, including addition, multiplication, and conversion to exponential form, and understand their algebraic properties.

CO6: Explore and apply the algebraic and order properties of real numbers, and comprehend the concept of the absolute value in the context of the real line.

CO7: Analyze sequences and their limits, apply limit theorems, and understand the concepts of monotone sequences and the extension of limit concepts to functions.

Topics and Learning Points

	Teaching Hours
Unit 1: Sets, Relations and Functions	**3**
1.1 Sets and basic operations on sets	
1.2 Relations, Equivalence relations, Equivalence classes and Partition of sets.	
1.3 Functions, Types of functions, Inverse of a function, Composition of functions.	
Unit 2: Divisibility theory in the integers	**4**
2.1 Mathematical induction: Well-Ordering Principle.	
2.2 The division algorithm	
2.3 The greatest common divisor	
2.4 The Euclidean algorithm	
Unit 3: Primes and theory of congruences	**4**
3.1 The fundamental theorem of arithmetic	
3.2 Basic properties of congruences	
Unit 4: Complex Numbers	**4**
4.1 Sum and product	
4.2 Basic algebraic properties	
4.3 Moduli	
4.4 Complex conjugate	
4.5 Exponential form	
Unit 5: Real Numbers	**3**
5.1 The Algebriac and Order Properties of R	
5.2 Absolute Value and the Real Line	
Unit 6: Sequences	**6**
6.1 Sequences and Their Limits	
6.2 Limits Theorems	
6.3 Monotone Sequences	
Unit 7: Limits	**6**
7.1 Functions	
7.2 Limits of Functions	
7.3 Limit Theorems	
7.4 Extension of limit concepts	

Text Books:

1. Ajit Kumar, S. Kumaresan and Bhaba Kumar Sarma, *A Foundation Course in Mathematics,* Narosa Publication House, 2018. **Unit 1**
2. David M. Burton, *Elementary Number Theory,* Tata McGraw Hill, 7th Edition, 2012. **Unit 2**, **Unit 3**.
3. Ruel V. Churchill, James W. Brown, *Complex Variables and Applications,* McGraw-Hill, Eighth Edition. **Unit 4**.
4. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition. **Unit 5, 6 and 7**

Reference Books:

1. Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, Tata McGraw Hill.
2. Seymour Lipschutz, *Set Theory and Related Topics*, Schqum's Ountline Series.
3. Robin Wilson, *Number Theory: A very short introduction*, Oxford University Press.
4. Verity Carr, *Complex Numbers: Made Simple*, Made Simple Books.
5. Introduction to Real analysis, William F. Trench, Free edition, 2010.
6. Calculus of a single variable Ron Larson, Bruce Edwards, tenth edition.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : I
Course Type : Practical
Course Name : Algebra and Calculus Practical with Python
Course Code : MAT-102-GEN
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Gain hands-on experience in using Python to investigate sets, relations, and functions, enhancing their understanding of these fundamental algebraic concepts.
2. Develop skills to use Python for exploring divisibility rules, algorithms, and properties of integers, reinforcing theoretical knowledge with practical programming.
3. Implement Python programs to identify and analyze prime numbers, solve congruence equations, and understand their applications in number theory.
4. Learn to perform complex number operations using Python, including addition, multiplication, and conversion to exponential form, and visualize their properties.
5. Use Python to factorize and solve polynomial equations, analyze polynomial functions, and understand their significance in algebra.
6. Acquire practical experience in performing matrix operations using Python, including addition, multiplication, inversion, and solving linear equations.
7. Develop proficiency in using Python to explore real numbers, sequences, limits, continuity, and derivatives, and apply these concepts to solve practical problems in physics, engineering, and economics.

Course Outcomes:

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

CO1: Apply Python programming to explore and analyze sets, relations, and functions, and understand their properties and applications in algebra.

CO2: Use Python to investigate the divisibility of integers, perform divisibility tests, and understand related algorithms.

CO3: Implement Python programs to study primes, their properties, and solve congruence problems in number theory.

CO4: Use Python to perform arithmetic operations on complex numbers, explore their properties, and convert between different forms.

CO5: Utilize Python to factorize polynomials, solve polynomial equations, and understand polynomial functions.

CO6: Implement and apply matrix operations using Python, including addition, multiplication, inversion, and solving systems of linear equations.

CO7: Use Python to understand and analyze real numbers, sequences, limits, continuity, and derivatives, and apply these concepts to solve real-world problems in various fields.

Topics and Learning Points

Teaching Hours

Algebra Practical using Python Programming: 30

1) Exploring sets, relations and functions
2) Unravelling the secrets of divisibility of integers
3) Unveiling the mysteries of primes and congruences
4) Journey in the world of complex numbers
5) Exploring Polynomial: From factoring to solving equations
6) Discovering the power of Matrices

Calculus Practical using Python Programming: 30

1. Embarking on a journey with real numbers
2. Unravelling the fascinating world of sequences
3. Pushing the boundaries: exploring limits
4. The art of smoothness: Understanding continuity
5. The Calculus of change: Exploring derivatives and rate of change
6. Calculus in Action: Applications in Physics, Engineering and Economics

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : I
Course Type : Open Elective (OE)
Course Name : Basic Mathematics
Course Code : MAT-103-OE
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Develop a strong understanding of whole numbers, including their properties and operations.
2. Master the basic operations on numbers, such as addition, subtraction, multiplication, and division.
3. Gain proficiency in working with integers and understand their properties and applications.
4. Acquire a solid foundation in working with fractions, including operations and simplification.
5. Learn the language of algebra, including evaluating, simplifying, and translating expressions.
6. Develop problem-solving skills by solving equations and applying prime factorization and LCM.
7. Enhance mathematical reasoning and critical thinking skills through the application of integers in equation-solving.

Course Outcomes:

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

CO1: Demonstrate a comprehensive understanding of whole numbers and their properties, and apply them to solve mathematical problems.
CO2: Perform basic operations on numbers accurately and efficiently, and apply them to solve real-life problems.
CO3: Apply the concepts of integers in various mathematical contexts, including solving equations and analyzing number patterns.
CO4: Work proficiently with fractions, simplifying them and applying them in solving problems involving ratios and rates.
CO5: Evaluate, simplify, and translate algebraic expressions, and solve equations using appropriate techniques.
CO6: Apply prime factorization and LCM methods to solve problems involving integers and equations.
CO7: Develop graphical literacy by understanding the rectangular coordinate system, graphing linear equations, and interpreting slope as a measure of rate of change.

Topics and Learning Points

	Teaching Hours
Unit 1: Numbers	**6**
1.1 Introduction to whole numbers	
1.2 Basic operation on numbers	
1.3 Integers	
1.4 Fractions	
Unit 2: The language of Algebra	**8**
2.1 Evaluate, simplify and translate expression	
2.2 Solving equations	
2.3 Prime factorization	
2.4 LCM	
2.5 Solving equations using integers	
Unit 3: Decimals and Percents	**8**
3.1 Decimal Operations	
3.2 Averages and Probabilities	
3.3 Ratios and rate	
3.4 Applications of percents	
Unit 4: Graphs	**8**
4.1 Rectangular coordinate system	
4.2 Graphing linear equations	
4.3 Understanding slope of a line	

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 (2024 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : I
Course Type : Skill Enhancement Course (SEC)
Course Name : Scilab Software
Course Code : MAT-104-SEC
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Set up and become familiar with the Scilab environment, mastering basic operations and navigation.
2. Develop proficiency in performing arithmetic and symbolic computations using Scilab.
3. Gain the ability to solve systems of linear equations using Scilab, reinforcing their understanding of linear algebra.
4. Enhance their skills in calculus by performing differentiation and integration operations using Scilab.
5. Master matrix operations in Scilab, including addition, multiplication, and inversion.
6. Learn to effectively plot and visualize data and mathematical functions using Scilab's visualization tools.
7. Acquire advanced computational skills in Scilab to handle complex mathematical problems.

Course Outcomes:

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

CO1: Set up the Scilab environment, navigate its interface, and perform basic operations effectively.
CO2: Execute arithmetic operations and symbolic computations using Scilab for mathematical problem-solving.
CO3: Use Scilab to solve systems of linear equations, enhancing their understanding of linear algebra applications.
CO4: Perform calculus operations such as differentiation and integration using Scilab, facilitating the analysis of mathematical functions.
CO5: Conduct various matrix computations, including addition, multiplication, and inversion using Scilab.
CO6: Create and interpret graphical representations of data and mathematical functions using Scilab's plotting capabilities.
CO7: Apply Scilab for advanced mathematical and computational tasks, developing skills in handling complex problems.

Topics and Learning Points

Teaching Hours

Theory: Scilab software **12**

1) Introduction to Scilab
2) Plotting and visualizations
3) Applications of Scilab

Practical: **48**

1. Introduction to Scilab: Environment setup and basic operations
2. Arithmetic operations and symbolic computations in Scilab
3. Solving system of linear equations using Scilab
4. Calculus with Scilab
5. Matrix computations in Scilab
6. Plotting and visualization techniques in Scilab
7. Advance computation in Scilab
8. Polynomial operations in Scilab
9. Exploring trigonometric function using Scilab
10. Algebraic manipulations in Scilab
11. Differentiation in Scilab
12. Applications

Reference Books:

1. Tejas Sheth, Satish Annigeri and Rajesh Jakhotia, *Scilab: A practical introduction to programming and problem solving.*

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Theory
Course Name : Geometry and Differential Calculus
Course Code : MAT-151-GEN
No. of Teaching Hours : 30
No. of Credits : 2

Course Objectives:

1. Gain proficiency in the concepts of the locus of points, change of axes, and the general equation of the second degree.
2. Identify the center of conics and reduce their equations to standard forms, enhancing their understanding of conic sections.
3. Develop skills in working with rectangular Cartesian coordinates in space and understanding direction cosines and angles between lines.
4. Master the equations of planes, including normal form and first-degree equations in x, y, z, and determine planes under various conditions.
5. Learn to write equations of lines in symmetric and asymmetric forms, calculate angles between lines and planes, and identify coplanar lines.
6. Define and derive the equations of spheres in various forms, and analyze their plane sections and intersections with other spheres.
7. Learn the definition and properties of the Riemann integral and determine the integrability of functions.

Course Outcomes:

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

CO1: Use analytical geometry techniques to solve problems involving the locus of points and the transformation of coordinate axes.
CO2: Analyze the general equation of the second degree and reduce it to its standard form to identify different conic sections.
CO3: Solve problems involving rectangular Cartesian coordinates, direction cosines, and the angles between lines in space.
CO4: Formulate and analyze equations of planes in various forms, including the normal form and under given conditions.
CO5: Develop the ability to write and interpret equations of lines in space, calculate angles between lines and planes, and determine coplanarity.
CO6: Understand the properties and equations of spheres, and solve problems involving plane sections and intersections of spheres.
CO7: Understand and apply the concept of Riemann integration to determine the integrability of functions and calculate integrals.

Topics and Learning Points

	Teaching Hours
Unit 1: Analytical Geometry of two dimensions	**3**
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	**4**
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	
Unit 3: Lines in three dimensions	**4**
3.1 Equations of lines (Symmetric and asymmetric forms)	
3.2 Angle between the line and a plane	
3.3 Coplanar lines	
Unit 4: The Sphere	**4**
4.1 Definition and equation of the sphere in various forms	
4.2 Plane section of the sphere	
4.3 Intersection of two spheres	
Unit 5: Continuity	**4**
5.1 Continuous Functions	
5.2 Continuous Functions on Intervals	
Unit 6: Differentiation	**8**
6.1 The Derivative	
6.2 The Mean Value Theorem	
6.3 L'Hospital Rules	
Unit 7: Riemann Integration	**3**
7.1 Riemann Integral	
7.2 Riemann Integrable Functions	

Text Books:

1. Von Steuben, Analytic Geometry in two and three dimensions **Unit 1**
2. Shanti Narayan and P. K. Mittal, Analytical Solid Geometry, S. Chand **Unit 2**, **Unit 3 and Unit 4**
3. Introduction to Real Analysis by Robert.G. Bartle and Donald.R. Sherbert, John Wiley and Sons Inc, Fourth Edition. **Unit 5, Unit 6 and Unit 7**

Reference Books:

1. George Thomas and Ross Finney, Calculus and Analytical Geometry, Pearson Education.
2. P. K. Jain and Khalil Ahmed, A text book of Analytical Geometry of three dimensions, Wiley Eastern Ltd.
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 Pattern)

Name of the Programme : B.Sc. Mathematics
Program Code : USMT
Class : F.Y.B.Sc.
Semester : II
Course Type : Practical
Course Name : Geometry and Differential Calculus Practical with Geogebra
Course Code : MAT-152-GEN
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Develop proficiency in using GeoGebra to explore the locus of points and analyze the effects of changing coordinate axes.
2. Gain the ability to work with and graphically interpret the general equation of the second degree using GeoGebra.
3. Learn to identify the center of conic sections and reduce their equations to standard forms through GeoGebra.
4. Use GeoGebra to determine the equations of planes and calculate the length of perpendiculars from points to lines.
5. Develop skills in using GeoGebra to find the intersection of spheres and derive equations for circles and spheres through given points.
6. Utilize GeoGebra to visualize and comprehend the concepts of continuity and differentiability in functions.
7. Apply key calculus theorems, including the Mean Value Theorem, L'Hôpital's Rule, and Riemann integration, using GeoGebra to solve mathematical and practical problems.

Course Outcomes:

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

CO1: Create and analyze loci of points and understand the impact of changing axes using GeoGebra.
CO2: Work with the general equation of the second degree and interpret its geometric representation using GeoGebra.
CO3: Determine the center of conic sections and reduce their equations to standard forms using GeoGebra.
CO4: Find the equations of planes under given conditions and calculate the length of the perpendicular from a point to a line using GeoGebra.
CO5: Determine the intersection of two spheres and derive the equation of circles or spheres passing through given points using GeoGebra.
CO6: Use GeoGebra to visualize and understand the concepts of continuity and differentiability of functions.
CO7: Apply the Mean Value Theorem, L'Hôpital's Rule, and Riemann integration using GeoGebra for solving calculus problems and real-world applications.

Topics and Learning Points

Teaching Hours

Geometry Practical using GeoGebra: **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 Cir

Differential Calculus Practical using GeoGebra: **30**

7) Continuity
8) Derivative
9) Mean Value Theorem
10) L'Hôpital's Rule
11) Riemann Integration
12) Applications of Derivative

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 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
Course Code : MAT-153-OE
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Develop analytical and problem-solving skills through the exploration and analysis of patterns in sequences and series.
2. Enhance number sense and critical thinking by engaging in activities and games that involve playing with numbers.
3. Develop spatial visualization and geometrical reasoning skills through hands-on construction and manipulation of geometric figures.
4. Understand and apply financial mathematics concepts, including interest, investments, and budgeting, in real-life scenarios.
5. Gain a clear understanding of sets, relations, and functions, and their role in mathematical analysis and problem-solving.
6. Develop a conceptual understanding of mathematical induction and apply it to prove mathematical statements.
7. Enhance problem-solving strategies and develop mathematical thinking skills through solving a variety of mathematical problems.

Course Outcomes:

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

CO1: Analyze and recognize patterns in sequences and series, and apply them in solving mathematical problems and real-world scenarios.
CO2: Demonstrate an enhanced understanding of number properties and relationships through engaging in activities and games involving playing with numbers.
CO3: Construct and manipulate geometric figures accurately, demonstrating spatial visualization and reasoning abilities.
CO4: Apply financial mathematics principles to make informed financial decisions and solve problems related to personal finance.
CO5: Analyze probability scenarios and calculate probabilities, making informed decisions based on mathematical reasoning.
CO6: Apply the concepts of sets, relations, and functions in analyzing mathematical problems and real-world situations.
CO7: Students will be able to employ problem-solving strategies and mathematical thinking skills to solve a wide range of mathematical problems.

Topics and Learning Points

	Teaching Hours
Theory: Introduction	**12**

- Integers
- Geometrical shapes
- Cartesian coordinate system
- Financial mathematics

Practicals: **48**

1. Exploring Patterns: Analyzing sequences and series
2. Playing with numbers
3. Geometry in action: Constructing and manipulating geometric figures
4. Algebraic expressions and equations
5. Financial Mathematics
6. Problems on probability
7. What is Set?
8. What is Relation?
9. What is Function?
10. Mathematical induction
11. Problem solving strategies
12. Mathematical Modelling: Applying Mathematics to real world problems

CBCS Syllabus as per NEP 2020 for F.Y.B.Sc. Mathematics (2024 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 : Maxima Software
Course Code : MAT-154-SEC
No. of Teaching Hours : 60
No. of Credits : 2

Course Objectives:

1. Gain proficiency in expanding and simplifying polynomial expressions using Maxima for efficient algebraic manipulation.
2. Develop skills to factorize both simple and complex quadratic equations using Maxima, enhancing algebraic problem-solving techniques.
3. Learn to calculate first and higher-order derivatives of functions using Maxima, applying differentiation in various mathematical contexts.
4. Understand and apply integral calculus by evaluating indefinite and definite integrals of basic functions using Maxima.
5. Master the computation of limits of functions as they approach specific values or infinity using Maxima, reinforcing understanding of limits.
6. Acquire the ability to solve simple first-order differential equations analytically and with initial conditions using Maxima.
7. Develop competency in using Maxima for various mathematical operations, enhancing computational problem-solving abilities and mathematical understanding.

Course Outcomes:

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

CO1: Expand and simplify polynomial expressions using Maxima, demonstrating a clear understanding of polynomial manipulation.
CO2: Factorize both simple and complex quadratic equations using Maxima, showcasing proficiency in algebraic techniques.
CO3: Calculate the first and higher-order derivatives of functions using Maxima, applying differentiation techniques accurately.
CO4: Evaluate indefinite and definite integrals of basic functions using Maxima, understanding integral calculus applications.
CO5: Compute the limits of functions as they approach specific values or infinity using Maxima, reinforcing concepts of limits and continuity.
CO6: Solve simple first-order differential equations analytically and with initial conditions using Maxima, applying differential equation-solving methods.
CO7: Utilize Maxima for a range of mathematical operations, enhancing problem-solving skills and understanding of mathematical concepts through computational tools.

Topics and Learning Points

	Teaching Hours
Theory: Maxima software	**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. Combine Expansion and Simplification of Polynomial Expressions in Maxima.
3. Factorize a Simple Quadratic Equation in Maxima.
4. Factorize a Complex Quadratic Equation in Maxima.
5. Calculate the First Derivative of a Function in Maxima.
6. Calculate Higher-Order Derivatives of a Function in Maxima.
7. Evaluate Indefinite Integrals of Basic Functions in Maxima.
8. Evaluate Definite Integrals with Given Limits in Maxima.
9. Compute the Limit of a Function as it Approaches a Specific Value in Maxima.
10. Compute the Limit of a Function as it Approaches Infinity in Maxima.
11. Solve a Simple First-Order Differential Equation Analytically in Maxima.
12. Solve a First-Order Differential Equation with Initial Conditions in Maxima.

Reference Books:

1. Edwin L. Woollett, *Maxima by example: A step by step introduction to computer algebra using Maxima*