

Anekant Education Society's

**Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati**

(Autonomous)

**Department of Mathematics**

**2019 Pattern**

**F. Y. B. Sc. (Mathematics)**

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
I	USMT111	Algebra	2	36
	USMT112	Calculus	2	36
	USMT113	Practical based on USMT111 and USMT112	2	48
II	USMT121	Geometry	2	36
	USMT122	Calculus and Differential Equations	2	36
	USMT123	Practical based on USMT121 and USMT122	2	48

**Equivalence of the old syllabus with the new syllabus**

Old Course		New Course	
MAT 1201	Geometry	USMT121	Geometry
MAT 1202	Calculus-II	USMT122	Calculus and Differential Equations
MAT 1203	Practical based on MAT 1201 and MAT 1202	USMT123	Practical based on USMT121 and USMT122

## Choice Based Credit System Syllabus (2022 Pattern)

**Class:** F.Y.B.Sc. (Semester – II)

**Course Code:** USMT121

**Course:** 1

**Credit:** 2

**Title of the Course:** Geometry

**No. of Lectures:** 36

### A) Course Objectives:

1. Understand and 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.

### B) Course Outcomes:

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

### TOPICS/CONTENTS:

#### Unit 1: Analytical Geometry of two dimensions

[10 Lectures]

- 1.1 Change of axes: Translation and Rotation
- 1.2 General equation of second degree in two variables
- 1.3 Reduction to standard form

#### Unit 2: Planes in three dimensions

[10 Lectures]

- 2.1 Direction cosines and direction ratios
- 2.2 Equation of the plane: Normal form, Transform to the normal form
- 2.3 Planes passing through three non-collinear points
- 2.4 Intercept form
- 2.5 Angle between two planes
- 2.6 Distance of a point from a plane
- 2.7 Distance between parallel planes
- 2.8 System of planes
- 2.9 Two sides of planes
- 2.10 Bisectors of angles between two planes

### **Unit 3: Lines in three dimensions**

[8 Lectures]

- 3.1 Equations of lines in symmetric and asymmetric forms
- 3.2 Line passing through two points
- 3.3 Angle between a line and a plane
- 3.4 Coplanar lines
- 3.5 Skew lines
- 3.6 Distance of a point from a line

### **Unit 4: The Sphere**

[8 Lectures]

- 4.1 Equation of a sphere
- 4.2 Plane section of a sphere
- 4.3 Intersection of two spheres
- 4.4 Sphere through a given circle
- 4.5 Intersection of a sphere and a line
- 4.6 Equation of tangent plane

### **Text Books:**

1. **Analytic Geometry in Two and Three Dimensions**, *Von Steuben*  
**Unit 1:** Sections: 8.4.
2. **Analytical Solid Geometry**, *Shantinayakan*, S. Chand and Company Ltd., New Delhi, 1998.  
**Unit 2:** Sections: 1.6, 1.7, 2.1 to 2.7; **Unit 3:** Sections: 3.1 to 3.4, 3.7;  
**Unit 4:** Sections: 6.1 to 6.6.

### **Reference Books:**

1. Analytical Geometry of 2D and 3D, *P. R. Vittal*, Pearson, 2013.
2. A Textbook of Two Dimensional Geometry, *Sat Pal and Harbans Lal*, New Age International Publishers.
3. Textbook of Analytical Geometry of Three Dimensions, *P. K. Jain and Khalil Ahmad*, New Age International Publishers.
4. Theory and Problems of Plane and Solid Analytic Geometry, *Joseph H. Kindle*, Schaum's Outline Series.

## Mapping of Program Outcomes with Course Outcomes

**Class:** FYBSc (Sem II)

**Subject:** Mathematics

**Course:** Geometry

**Course Code:** USMT121

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

Course Outcomes	Programme Outcomes (POs)								
	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 (2022 Pattern)

**Class:** F.Y.B.Sc. (Semester – II)

**Course Code:** USMT122

**Course:** 2

**Credit:** 2

**Title of the Course:** Calculus and Differential Equations

**No. of Lectures:** 36

### A) Course Objectives:

1. To understand definition of differentiation using limits.
2. To apply differentiation for advanced study in Mathematics.
3. To develop the theoretical as well as applied, computational skills and gains the confidence in proving theorems and solving problems.
4. To calculate limits of a function using Hospital Rule.
5. To find  $n^{\text{th}}$  derivatives of product of function using Leibnitz Rule.
6. To solve first order differential equation of various methods.
7. To relate graphs and theoretical concepts in calculus efficiently.

### B) Course Outcomes:

1. Students will able to understand definition of differentiation using limits.
2. Students will apply these concepts for advanced study in Mathematics (Real Analysis, Complex Analysis, topology).
3. Students can develop the theoretical as well as applied, computational skills and gains the confidence in proving theorems and solving problems.
4. Students will able to calculate limits of a function using Hospital Rule.
5. Students will able to find  $n^{\text{th}}$  derivatives of product of function using Leibnitz Rule.
6. Students will able to solve first order differential equation of various methods.
7. Students will able to relate graphs and theoretical concepts in calculus efficiently.

## TOPICS/CONTENT

### Unit 1: Differentiation

[12 lectures]

#### 1.1 The Derivative:

The definition of derivative at a point, relationship between differentiability and continuity, Rules for Differentiation, Caratheodory's Theorem (without Proof), The Chain Rule, Derivative of inverse function.

#### 1.2 The Mean Value Theorem:

Interior Extremum Theorem, Rolle's Theorem, Mean Value Theorem, Cauchy Mean Value Theorem, Intervals of increasing and decreasing functions, First Derivative Test for Maxima, Intermediate Value Theorem, Darboux's Theorem.

### Unit 2:L'Hospital's Rule and Successive Differentiation

[14 lectures]

#### 2.1 L'Hospital Rule: Indeterminate Forms, L'Hospital Rules (without proof)

2.2 Taylor's Theorem: Taylor's Theorem (without proof), MacLaurin's theorem with Lagrange's form remainder

2.3 Successive Differentiation: The  $n^{\text{th}}$  derivative and Leibnitz theorem for successive differentiation.

### Unit 3: Ordinary Differential Equations

[10 lectures]

3.1 First Order Differential Equations: First order linear differential equation, separable equations, Homogeneous equations

**3.2** Orthogonal Trajectories: Formation of Differential equation, orthogonal trajectory, Existence and uniqueness of solutions

**3.3** Exact Equations: Exact differential equations, Integrating Factors.

**Textbooks:**

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.  
Unit 1: Sec 6.1 and Sec. 6.2, Unit 2: Sec 6.3 and Sec. 6.4
2. Differential Equations by George F. Simmons, Steven G. Krantz, Tata McGrawHill.  
Unit 3: Sec 1.3 to Sec 1.8

**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

**Mapping of Program Outcomes with Course Outcomes**

**Class:** FYBSc (Sem II)

**Subject:** Mathematics

**Course:** Calculus and Differential Equations

**Course Code:** USMT122

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

Course Outcomes	Programme Outcomes (POs)								
	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		2	2				
CO 3	3	2		2					
CO 4	3	2							
CO 5	3								
CO 6	3	2							
CO 7	3			2	2	2			2

**Justification for the mapping**

**PO 1: Disciplinary Knowledge:**

All of these COs contribute to development of student’s disciplinary knowledge. For example, CO1, CO2, CO3 requires to think students critically to apply differentiation, behaviour of functions in various fields. CO5, CO6 and CO7 requires to develop deep understanding of integration, dependent variable and independent variables in view of differential equation and use it to solve real world problems.

**PO2: Critical Thinking and Problem Solving:**

CO1, CO2 and CO4 requires to development of student's knowledge of derivative, Mean Value theorems, integration to find orthogonal trajectory, critical points of a function, to solve problems related to accuracy, area calculation etc. CO3, CO6 contribute to development of students understanding to solve real world problems in different fields by using differentiation.

**PO4: Research-related skills and Scientific temper:**

CO2, CO3, CO7 requires to develop student's research related skills. Student's will able to apply the tools of calculus 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 requires to demonstrate the student's 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 (2022 Pattern)

**Class:** F.Y.B.Sc. (Semester – I)

**Course Code:** USMT123

**Course:** 3

**Title of the Course:** Practical based on USMT121 & USMT122

**Credit:** 2

**No. of Lectures:** 48

### A) Course Objectives:

1. To draw the graphs of algebraic and transcendental functions considering limits and continuity.
2. To master the techniques of translating and rotating coordinate axes.
3. To apply differentiation for advanced study in Mathematics.
4. To Learn to find direction cosines and angle between lines using direction cosines.
5. To relate graphs and theoretical concepts in calculus efficiently.
6. To develop the ability to determine and apply the equation of a tangent plane to a sphere, demonstrating a clear understanding of this geometric concept.
7. To apply continuity and differentiation concept in physical, chemical, and biological sciences.

### B) Course Outcomes:

1. Students will able to apply definition of continuity to pure and applied problems.
2. Students will be able to reduce equations to standard forms and determine various properties associated with them.
3. Students will able to understand definition of differentiation using limits.
4. Students will be able to calculate direction cosines and angle between lines using coordinate geometry techniques.
5. Students can develop the theoretical as well as applied, computational skills and gains the confidence in proving theorems and solving problems.
6. Students will be able to determine and apply the equation of tangent plane to a sphere, illustrating a high-level proficiency in this advanced geometric concept.
7. Students will apply continuity and differentiation concept in physical, chemical, and biological sciences.

### Title of Experiments:

#### Geometry-

1. Analytical Geometry of two dimensions
2. Planes in three dimensions
3. Lines in three dimensions
4. Sphere
5. History of Geometry
6. Geometry using Maxima Software

#### Calculus and Differential Equations-

7. Differentiation
8. Mean Value Theorem

9. L'Hospital's Rule
10. Successive Differentiation
11. Ordinary Differential Equations
12. Differentiability using Maxima Software

### Mapping of Program Outcomes with Course Outcomes

**Class:** FYBSc (Sem II)

**Subject:** Mathematics

**Course:** Practical based on USMT121 & USMT122

**Course Code:** USMT123

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

Course Outcomes	Programme Outcomes (POs)								
	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		2	2				
CO 3	3	2		2					
CO 4	3	2							
CO 5	3			2					
CO 6	3	2		2					
CO 7	3			2	2	2			2

#### Justification for the mapping

**PO 1: Disciplinary Knowledge:**

All of these COs contribute to development of student's disciplinary knowledge. For example, CO1, CO2, CO3 requires to think students critically to apply differentiation, behaviour of functions in various fields. CO5, CO6 and CO7 requires to develop deep understanding of continuity, limits of a function, differentiation and use it to solve real world problems.

**PO2: Critical Thinking and Problem Solving:**

CO1, CO2 and CO4 requires to development of student's knowledge of derivative, Mean Value theorems, integration to find critical points of a function, to solve problems related to accuracy etc. CO3, CO6 contribute to development of students understanding to solve real world problems in different fields by using behaviour of functions.

**PO4: Research-related skills and Scientific temper:**

CO2, CO3, CO5, CO6, CO7 requires to develop students research related skills. Student's will able to apply the tools of calculus to various real-world problems in different areas.

**PO5: Trans-disciplinary Knowledge:**

CO7: Students will apply mathematical concept such as Continuity, limits and differentiation. These concepts are useful in many different fields such as Physics, engineering, chemistry and economics.

**PO6: Personal and professional competence:**

CO7 requires to demonstrate the student's ability to apply mathematical concept such as continuity and derivative 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.