



**R.E. Society's  
R. P. Gogate College of Arts & Science  
and R. V. Jogalekar College of  
Commerce (Autonomous), Ratnagiri**

**Bachelor of Science (B.Sc.) Mathematics  
Programme**

**Three Year Integrated Programme**

**Six Semesters**

**Syllabus for Semester : V & VI**

**Under Choice Based Credit System (CBCS)**

**To be implemented from Academic Year-  
2025-2026**

Name of Programme	<b>B.Sc. Mathematics</b>
Level	UG
No of Semesters	06
Year of Implementation	<b>2025-26</b>
Programme Specific Outcomes (PSO)	<ol style="list-style-type: none"> <li>1. Learner shall able to develop positive attitude towards mathematics as an interesting and valuable subject.</li> <li>2. Enhancing students' overall development and to equip them with mathematical modelling, abilities, problem solving skills, creative talent.</li> <li>3. Learner should be able to acquire good knowledge and understanding in advanced areas of mathematics.</li> <li>4. Learner should apply Mathematical models to the problems of society.</li> </ol>
Relevance of PSOs to the local, regional, national, and global developmental needs	<p>Mathematics is useful at Global, Regional and local level. Better understanding of mathematics helps the student to visualize the solution of the problems in society. The application part is taken care of so that the learner should be able to create mathematical models to the problems in society. The skill set, knowledge acquired during the completion of programme shall make him employable in fields like Teaching, Banking, Research analyst, various IT industries.</p>

**Evaluation Scheme:**

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Continuous Internal Evaluation with 40% marks in the first part and by conducting the Semester End Examinations with 60% marks in the second part. The allocation of marks for the Internal Assessment and Semester End Examinations is given under every course.

**Standard of Passing:**

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Continuous Internal Evaluation & Semester End Examination. The learner shall obtain minimum of 40% marks in the CIE and 40% marks in SEE separately, to pass the course and minimum of Letter Grade "P" in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the CIE & SEE together.

**Performance Grading:****Credit, Letter Grades and Grade Points**

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result	Credits Earned
9.00-10.00	90.0 -100	O (Outstanding)	As per mentioned for every course
$8.00 \leq 9.00$	$80.0 \leq 90.0$	A+ (Excellent)	
$7.00 \leq 8.00$	$70.0 \leq 80.0$	A (Very Good)	
$6.00 \leq 7.00$	$60.0 \leq 70.0$	B+ (Good)	
$5.50 \leq 6.00$	$55.0 \leq 60.0$	B (Above Average)	
$5.00 \leq 5.50$	$50.0 \leq 55.0$	C (Average)	
$4.00 \leq 5.00$	$40.0 \leq 50.0$	P (Pass)	
Below 4.00	Below 40	F (Fail)	0
Ab (Absent)	-	Absent	

Bachelor of Science (B.Sc.) Mathematics Programme  
Under Choice Based Credit System  
Course Structure

T. Y. B.Sc.-Mathematics

(To be implemented from Academic Year- 2025-26)

Course Code	Semester V	Credits	Course Code	Semester VI	Credits
Discipline Specific Course (DSC)			Discipline Specific Course (DSC)		
Major Mandatory			Major Mandatory		
25_USMTM501	Calculus IV	2	25_USMTM601	Real Analysis II	2
25_USMTM502	Group Theory	2	25_USMTM602	Ring Theory	2
25_USMTM503	Topology of Metric Spaces I	2	25_USMTM603	Topology of Metric Spaces II	2
25_USMTM504	Practical-5 (Based on 25_USMTM501 & 25_USMTM503)	2	25_USMTM604	Practical-7 (Based on 25_USMTM601 & 25_USMTM603)	2
25_USMTM505	Practical-6 (Based on 25_USMTM502)	2	25_USMTM605	Practical-8 (Based on 25_USMTM602)	2
Major Elective (Any one)			Major Elective (Any one)		
25_USMTE506	Graph Theory	2	25_USMTE606	Laplace Transform	2
25_USMTE507	Practical-Graph Theory	2	25_USMTE607	Discrete Mathematics II	2
OR			OR		
25_USMTE508	Numerical Analysis	2	25_USMTE608	Number Theory	2
25_USMTE509	Practical-Numerical Analysis	2	25_USMTE609	Practical-Number Theory	2
Vocational Skill Course (VSC)			Vocational Skill Course (VSC)		
25_USMTV510	Microsoft Excel	4	25_USMTV610	Python Programming	4
Field Project			On Job Training		
25_USMTF511	Field Project	4	25_USMTJ611	On Job Training	4
Total Credits		22	Total Credits		22

**Teaching Pattern:** 2/4 lectures per week per theory/practical course of two credits.

**Revised Syllabus of Courses of  
Bachelor of Science (B.Sc.) Mathematics Programme at Semester V  
with Effect from the Academic Year 2025-2026**

Course Code	Semester V	Credits
Major Mandatory		
25_USMTM501	Calculus IV	2
25_USMTM502	Group Theory	2
25_USMTM503	Topology of Metric Spaces I	2
25_USMTM504	Practical-5 (Based on 25_USMTM501 & 25_USMTM503)	2
25_USMTM505	Practical-6 (Based on 25_USMTM502)	2
Major Elective (Any one)		
25_USMTE506	Graph Theory	2
25_USMTE507	Practical-Graph Theory	2
OR		
25_USMTE508	Numerical Analysis	2
25_USMTE509	Practical-Numerical Analysis	2
Vocational Skill Course (VSC)		
25_USMTV510	Basic + Advanced Excel	4
Field Project		
25_USMTF511	Field Project	4
Total Credits		22

Name of the Course	Calculus IV
Course Code	25_USMTM501
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives introduction to some important concepts of integration and finding area bounded by curves, one of the most important topics from integral calculus rigor and prepares students to study further courses in Calculus and related fields. This course contains the concepts Multivariable Calculus of which are used for Research in Mathematics.

Unit No.	Units	No. of Lectures
1	Multiple Integrals	10
2	Line Integrals	10
3	Surface Integrals	10

## Nomenclature : Calculus IV

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Learn the basic ideas, tools and techniques of integral calculus
  2. Apply these techniques to solve problems from real-life applications
  3. Examine vector fields and define and evaluate line integrals
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### Curriculum :

Unit No.	Title and Learning Points
1	Multiple Integrals 10 Lectures
	1.1 Definition of double (resp: triple) integral of a function and bounded on a rectangle (resp:box). Geometric interpretation as area and volume. Fubini's Theorem over rectangles and any closed bounded sets, Iterated Integrals 1.2 Integrability of the sums, scalar multiples, products, and (under suitable conditions) quotients of integrable functions. Formulae for the integrals of sums and scalar multiples of integrable functions 1.3 Integrability of continuous functions. More generally, Integrability of functions with a "small" set of (Here, the notion of "small sets" should include finite unions of graphs of continuous functions.). 1.4 Domain additivity of the integral. Integrability and the integral over arbitrary bounded domains. Change of variables formula (Statement only). Polar, cylindrical and spherical coordinates, and integration using these coordinates. Differentiation under the integral sign. Applications to finding the center of gravity and moments of inertia
2	Line Integrals 10 Lectures
	2.1 Review of Scalar and Vector fields on $R^n$ , Vector Differential Operators, Gradient, Curl, Divergence 2.2 Paths (parametrized curves) in $R^n$ (emphasis on $R^2$ and $R^3$ ), Smooth and piecewise smooth paths. Closed paths. Equivalence and orientation preserving equivalence of paths 2.3 Definition of the line integral of a vector field over a piecewise smooth path. Basic properties of line integrals including linearity, path-additivity and behaviour under a change of parameters. 2.4 Line integrals of the gradient vector field, Fundamental Theorem of Calculus for Line Integrals, Necessary and sufficient conditions for a vector field to be conservative. Green's Theorem (proof in the case of rectangular domains)
3	Surface Integrals 10 Lectures

	<p>3.1 Parameterized surfaces. Smoothly equivalent parameterizations. Area of such surfaces</p> <p>3.2 Definition of surface integrals of scalar-valued functions as well as of vector fields defined on a surface.</p> <p>3.3 Curl and divergence of a vector field. Elementary identities involving gradient, curl and divergence.</p> <p>3.4 Stoke's Theorem (proof assuming the general form of Green's Theorem).</p> <p>3.5 Gauss' Divergence Theorem (proof only in the case of cubical domains)</p>
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**Learning Resources Recommended :**

1. Apostol, Calculus, Vol. 2, Second Ed., John Wiley, New York, 1969 Section 1.1 to 1.8
  2. James Stewart, Calculus with Early Transcendental Functions-Section 16.5 to 16.9
  3. Marsden and Jerrold E. Tromba, Vector Calculus, Fourth Ed., W.H. Freeman and Co., New York, 1996 Section 6.2 to 6.4
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**Evaluation Scheme :**

**A. Continuous Evaluation (20 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

**B. Semester End Evaluation (30 Marks - 1 Hour)**

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Group Theory
Course Code	25_USMTM502
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives introduction to group theory, one of the most important topics from Abstract Algebra with rigor and prepares students to study further courses in Abstract Algebra and related fields.

Unit No.	Units	No. of Lectures
1	Groups and Subgroups	10
2	Cyclic Groups, Cosets and Lagrange's Theorem	10
3	Quotient groups and Homomorphism	10

## Nomenclature : Group Theory

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. outline and illustrate basic properties and theorems of groups
  2. define and distinguish between various types of groups
  3. determine whether a given subset of a group is a subgroup or not.
  4. illustrate or outline basic properties or theorems of cyclic groups
  5. illustrate homomorphism on groups, quotient groups and normal subgroups. Carryout, outline and illustrate theorems on these concepts
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### Curriculum :

Unit No.	Title and Learning Points	
1	Groups and Subgroups	10 Lectures
	1.1 Definition of a group and Abelian group, Order of a group. 1.2 Examples of Groups including $\mathbb{Z}$ , $\mathbb{Q}$ , $\mathbb{R}$ , $\mathbb{C}$ , $n\mathbb{Z}$ , $\mathbb{Z}_n$ , Klein-4 group, symmetric and alternating groups $GL_n(\mathbb{R})$ , $SL_n(\mathbb{R})$ , group of symmetries of plane figures. 1.3 General properties of a group, Order of an Element 1.4 Definition of a Subgroup, Criterion for a subset to be a subgroup and Examples 1.5 Definition of Center of a group and Normalizer of a group.	
2	Cyclic groups, cosets and Lagrange's Theorem	10 Lectures
	2.1 Properties, Examples of Cyclic Groups and Cyclic Subgroup 2.2 Finite Cyclic groups and their generators 2.3 Infinite Cyclic groups and their generators 2.4 Properties of generators 2.5 Definition of Cosets of a Subgroup in a Group and Examples & Properties of Cosets 2.6 Lagrange's Theorem and consequences, Index of a subgroup	
3	Quotient groups and Homomorphism	10 Lectures
	3.1 Definition of Normal subgroups, Characterization of normal subgroups. 3.2 Quotient group 3.3 Alternating group $A_n$ , cycles. Listing normal subgroup of $A_4$ , $S_3$ . 3.4 Group Homomorphisms, Kernel of a Homomorphism. 3.5 Properties of Homomorphisms 3.6 Isomorphism, Automorphism of groups: Definition and Examples 3.7 Isomorphism theorems: Fundamental Theorem of homomorphisms of groups, 2 <sup>nd</sup> isomorphism theorem, 3 <sup>rd</sup> isomorphism 3.8 Characterization of cyclic groups (as being isomorphic to $\mathbb{Z}$ or $\mathbb{Z}_n$ , for some $n \in \mathbb{N}$ )	

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**Learning Resources Recommended :**

1. Israel Herstein; Topics in Algebra; Second Edition, Wiley Eastern Limited
  2. P. B. Bhattacharya, S.K. Jain, S. Nagpaul; Abstract Algebra; Second Edition, Foundation Books, New Delhi, 1995M
  3. N. S. Gopalkrishnan, University Algebra, Wiley Eastern Limited.
  4. Michael Artin; Algebra; Prentice Hall of India, New Delhi.
  5. John Fraleigh; A First Course in Abstract Algebra; Third Edition, Narosa, New Delhi.
  6. Joseph Gallian; Contemporary Abstract Algebra; Narosa, New Delhi
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**Evaluation Scheme :****A. Continuous Evaluation (20 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

**B. Semester End Evaluation (30 Marks - 1 Hour)**

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Topology of Metric Spaces I
Course Code	25_USMTM503
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Metrics Space is the base of Real Analysis. This course develops basic skills of learning Mathematics at Undergraduate level.

Unit No.	Units	No. of Lectures
1	Metrics Spaces	10
2	Sequences in Metric Spaces	10
3	Continuous functions on Metric Spaces	10

## Nomenclature : Topology of Metric Spaces I

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Understand the concept of metric spaces and solve the problems on it.
  2. Understand the concept of sequences in metric spaces and solve the problems on it.
  3. Understand the concept of continuous functions on metric spaces and solve the problems on it.
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### Curriculum :

Unit No.	Title and Learning Points
1	Metric Spaces 10 Lectures
	1.1 Definition and examples of metric spaces, Discrete metric space 1.2 Metric induced by the norm, Translation invariance of the metric induced by the norm, Open balls and open sets in a metric space 1.3 Hausdorff property, Interior of a set, closed balls and closed sets 1.4 Limit point of a set, closure of a set
2	Sequences in Metric Spaces 10 Lectures
	2.1 Sequences in a metric space 2.2 Convergent sequence in a metric space 2.3 Cauchy sequence in a metric space 2.4 Subsequences 2.5 Characterization of limit points and closure points in terms of sequences
3	Continuous functions on Metric Spaces 10 Lectures
	3.1 Epsilon-Delta definition of continuity of a function at a point from one metric space to another. 3.2 Characterization of continuity at a point in terms of sequences. 3.3 Algebra of continuous real valued functions on a metric space. 3.4 Characterization of continuity in terms of Open sets and closed sets. 3.5 Continuity of composite function. 3.6 Uniform continuity in a metric space, examples (emphasis on $\mathbb{R}$ ).

### Learning Resources Recommended :

1. S. Kumaresan; Topology of Metric Spaces
  2. E. T. Copson; Metric Spaces; Universal Book Stall, New Delhi, 1996
  3. P. K. Jain, K. Ahmed; Metric Spaces; Narosa, New Delhi, 1996
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Practical-5 (Based on 25_USMTM501 & 25_USMTM503)
Course Code	25_USMTM504
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the courses 25_USMTM501 & 25_USMTM503

Unit No.	Units	No. of Lectures
1	Problems Based on Calculus IV	20
2	Problems based on Calculus IV and Topology of Metric Spaces I	20
3	Problems based on Topology of Metric Spaces I	20

**Nomenclature :** Practical-5 (Based on 25\_USMTM501 & 25\_USMTM503)

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**Course Outcomes :**

On successful completion of this course, a learner will be able to:

1. Solve problems based on Double and Triple Integrals
  2. Solve problems based on Line integral of scalar and vector field and Green's Theorem
  3. Solve problems based on Stoke's Theorem and Divergence Theorem
  4. Solve problems on concepts from Topology of Metric Spaces
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**Curriculum :**

Unit No.	Title and Learning Points	
1	Problems Based on Calculus IV	20 Lectures
	1. Evaluation of Double Integral and Triple Integral 2. Change of Variable in Double Integrals and Triple Integrals 3. Linear Integrals of Scalar Fields and Vector Fields 4. Application of Green's Theorem	
2	Problems based on Calculus IV and Topology of Metric Spaces I	20 Lectures
	1. Problems of Consecutive Field 2. Evaluation of Surface Integrals, Application of Stoke's Theorem and Divergence Theorem 3. Metric Spaces I 4. Metric Spaces II	
3	Problems based on Topology of Metric Spaces I	20 Lectures
	1. Sequences I 2. Sequences II 3. Continuous functions on Metric Spaces I 4. Continuous functions on Metric Spaces II	

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**Learning Resources Recommended :**

1. All resources recommended for 25\_USMTM501 & 25\_USMTM503
  2. Practical Question Bank Designed by Department of Mathematics, GJC
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Practical-6 (Based on 25_USMTM502)
Course Code	25_USMTM505
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the courses 25_USMTM502.

Unit No.	Units	No. of Lectures
1	Problem based on Groups and Subgroups	20
2	Problems based on Cyclic Groups, Cosets and Lagrange's Theorem	20
3	Problems based on Homomorphism and Quotient groups	20

**Nomenclature :** Practical-6 (Based on 25\_USMTM502)

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**Course Outcomes :**

On successful completion of this course, a learner will be able to:

1. Outline and illustrate basic properties and theorems of groups.
  2. Solve basic problems involving various groups and its subgroup.
  3. Solve examples on cyclic groups and their generators
  4. Illustrate, verify examples on homomorphism and isomorphism of groups
  5. Solve examples on quotient group and normal subgroups
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**Curriculum :**

Unit No.	Title and Learning Points
1	Problems based on Groups and Subgroups 20 Lectures
	<ol style="list-style-type: none"><li>1. Examples of groups, groups of symmetries of equilateral triangle, square and rectangle</li><li>2. Examples of determining centers and normalizer of different groups</li><li>3. Examples of subgroups of various groups and orders of elements in a group</li><li>4. Examples on Permutation group</li></ol>
2	Problems based on Cyclic Groups, Cosets and Lagrange's Theorem 20 Lectures
	<ol style="list-style-type: none"><li>1. cyclic groups, cyclic subgroups and their generators</li><li>2. Finite and Infinite cyclic groups</li><li>3. Examples on Left and Right Cosets of a group</li><li>4. Applications of Lagrange's Theorem</li></ol>
3	Problems based on Homomorphism and Quotient groups 20 Lectures
	<ol style="list-style-type: none"><li>1. Examples on Normal subgroups I</li><li>2. Examples on Normal subgroups II</li><li>3. Examples on Homomorphism, Isomorphism of groups</li><li>4. Examples on Quotient groups and isomorphism theorems.</li></ol>

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**Learning Resources Recommended :**

1. All resources recommended for 25\_USMTM502
  2. Practical Question Bank Designed by Department of Mathematics, GJC.
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Graph Theory
Course Code	25_USMTE506
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	This course contains the concepts of Graph Theory which are used for Research in Mathematics. With this, learner can create useful Mathematical Models for society.

Unit No.	Units	No. of Lectures
1	Basics of Graphs	10
2	Types of Graphs	10
3	Coloring of Graphs	10

## Nomenclature : Graph Theory

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. demonstrate the knowledge of fundamental concepts in Graph Theory
  2. Identify types of graphs such as bipartite graphs, Complete graphs
  3. Learn to identify tree, Eulerian, Hamiltonian, Planar Graphs
  4. Apply various algorithms to tree, Eulerian, Hamiltonian Planar Graphs
  5. Learn concept of coloring of graph
  6. Learn concept of chromatic polynomial
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### Curriculum :

Unit No.	Title and Learning Points	
1	Basics of Graph	10 Lectures
	1.1 Definition of Graph, Basic Terminologies-Degree, Adjacency, Types of graphs 1.2 Walk, Trail, Path, Cycle, Isomorphic Graphs, Handshaking Lemma 1.3 Bipartite Graph, Havel Hakimi Algorithm, Adjacency and Incidence Matrix 1.4 Planar Graphs, Euler Formula	
2	Types of Graphs	10 Lectures
	2.1 Definition Tree - Characterization, Cut Vertex, Cut Edge, its results 2.2 Cayley's Formula, Eulerian Graphs, Hamiltonian Graph-Characterization, 2.3 Dirac's Theorem, Ore's Theorem, Hamiltonian Closure	
3	Coloring of Graphs	10 Lectures
	3.1 Chromatic Number, Vertex coloring, edge coloring, 5-Colour Theorem 3.2 Chromatic Polynomial, recurrence relation of chromatic polynomial 3.3 Vertex and Edge Connectivity, Whitney's theorem	

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### Learning Resources Recommended :

1. Bondy and Murty; Graph Theory with Applications
  2. Balkrishnan and Ranganathan; Graph Theory and Applications
  3. Douglas B. West; Introduction to Graph Theory, 2nd Ed., Pearson, 2000
  4. Behzad and Chartrand; Graph Theory
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Practical-Graph Theory
Course Code	25_USMTE507
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the course 25_USMTE506

Unit No.	Units	No. of Lectures
1	Exercise-Type-1	20
2	Exercise-Type-2	20
3	Exercise-Type-3	20

## Nomenclature : Practical-Graph Theory

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Solve problems based on degree, matrix, order, size, Isomorphism etc.
  2. Apply algorithms on binary, rooted trees.
  3. Solve problems based on trees, Eulerian and Hamiltonian graphs.
  4. describe real-world applications of Graph Theory
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### Curriculum :

Unit No.	Title and Learning Points
1	Exercise-Type-1 <span style="float: right;">20 Lectures</span>
	<ol style="list-style-type: none"><li>1. Havel-Hakimi Algorithm problems</li><li>2. Isomorphisms, Non-Isomorphic Realizations</li><li>3. Problems based on Number of vertices, Edges degree etc.</li><li>4. Adjacency Matrix Problems</li><li>5. Dijkstra's Algorithm</li><li>6. Planar Graphs-Problems</li></ol>
2	Exercise-Type-2 <span style="float: right;">20 Lectures</span>
	<ol style="list-style-type: none"><li>1. Traversing a binary tree, Rooted Tree, Spanning Tree</li><li>2. Kruskal's Algorithm Problems, Prim's Algorithm Problems</li><li>3. Breadth First Search Algorithm, Depth First Search Algorithm</li><li>4. Spanning trees problems, Huffman Coding Algorithm</li><li>5. Line Graph, Hypercube Graph problems</li><li>6. Mixed problems on Line, Hypercube, Eulerian and Hamiltonian Graphs</li></ol>
3	Exercise-Type-3 <span style="float: right;">20 Lectures</span>
	<ol style="list-style-type: none"><li>1. Coloring of graphs</li><li>2. Problems on Chromatic number, Index</li><li>3. Chromatic Polynomial Problems</li><li>4. Vertex and Edge Connectivity</li><li>5. Real world applications</li></ol>

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### Learning Resources Recommended :

1. All resources recommended for 25\_USMTE506
  2. Practical Question Bank Designed by Department of Mathematics, GJC
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Numerical Analysis
Course Code	25_USMTE508
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Numerical Analysis is the study of algorithms that use numerical approximation for the problems of mathematical analysis. It is the study of numerical methods that attempt to find approximate solution of a problem rather than the exact ones. Numerical analysis find application in all fields of engineering and the physical sciences, and in the 21 <sup>st</sup> century also the life and social sciences, medicine, business and even the arts.

Unit No.	Units	No. of Lectures
1	Errors in Numerical Calculations and Solution of Algebraic and Transcendental Equations	10
2	Curve fitting and Interpolation	10
3	Numerical Integration and Numerical Solution of Linear System of Equations	10

## Nomenclature : Numerical Analysis

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Understand the concept of Errors in Numerical Calculations and Solution of Algebraic and Transcendental Equations and solve the problems based on it.
  2. Understand the concept of Curve fitting and Interpolation and solve the problems based on it
  3. Understand the concept of Numerical Integration and Numerical Solution of Linear System of Equations and solve the problems based on it
- 

### Curriculum :

Unit No.	Title and Learning Points	
1	Errors in Numerical Calculations and Solution of Algebraic and Transcendental Equations	10 Lectures
	1.1 Errors: Rounding off numbers to n significant digits, to n decimal places. 1.2 Relative, absolute and percentage errors 1.3 Solution of Equations: Bisection method, 1.4 Regula-Falsi method 1.5 Newton Raphson method 1.6 Secant Method	
2	Curve fitting and Interpolation	10 Lectures
	2.1 Least square method of fitting a straight line 2.2 Multiple linear least squares 2.3 Curve fitting by polynomials of degree 2 or 3 2.4 Finite difference operators: Forward difference operator, Backward difference operator, Shift operator 2.5 Lagrange's Interpolation 2.6 Newton's Forward difference interpolation formula 2.7 Newton's Backward difference interpolation formula	
3	Numerical Integration and Numerical Solution of Linear System of Equations	10 Lectures
	3.1 Newton-Cotes Quadrature formula 3.2 Trapezoidal Rule 3.3 Simpson's 1/3 Rule 3.4 Simpson's 3/8 Rule 3.5 Linear system of Equations: LU decomposition method (Dolittle's Method and Crout's Method) 3.6 Gauss Seidel Iteration Method	

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**Learning Resources Recommended :**

1. S. S. Sastry; Introductory Methods of Numerical Analysis, PHI
  2. Kendall E. and Atkinson: An Introduction to Numerical Analysis; Wiley.
  3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications
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**Evaluation Scheme :****A. Continuous Evaluation (20 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

**B. Semester End Evaluation (30 Marks - 1 Hour)**

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Practical-Numerical Analysis
Course Code	25_USMTE509
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the course 25_USMTE508

Unit No.	Units	No. of Lectures
1	Errors in Numerical Calculations and Solution of Algebraic and Transcendental Equations	20
2	Curve fitting and Interpolation	20
3	Numerical Integration and Numerical Solution of Linear System of Equations	20

## Nomenclature : Practical-Numerical Analysis

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Solve problems on concepts from Numerical Analysis
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### Curriculum :

Unit No.	Title and Learning Points	
1	Errors in Numerical Calculations and Solution of Algebraic and Transcendental Equations	20 Lectures
	<ol style="list-style-type: none"><li>1. Examples on Rounding off numbers to n significant digits, to n decimal places</li><li>2. Examples on Relative, absolute and percentage errors</li><li>3. Examples on Bisection method</li><li>4. Examples on Regula-Falsi method</li><li>5. Examples on Newton Raphson method</li><li>6. Examples on Secant method</li></ol>	
2	Curve fitting and Interpolation	20 Lectures
	<ol style="list-style-type: none"><li>1. Examples on Least square method of fitting a straight line</li><li>2. Examples on Multiple linear least squares</li><li>3. Examples on Curve fitting by polynomials of degree 2 or 3</li><li>4. Examples on Finite difference operators: Forward difference operator, Backward difference operator, Shift operator</li><li>5. Examples on Lagrange's Interpolation</li><li>6. Examples on Newton's Forward difference interpolation formula</li><li>7. Examples on Newton's Backward difference interpolation formula</li></ol>	
3	Numerical Integration and Numerical Solution of Linear System of Equations	20 Lectures
	<ol style="list-style-type: none"><li>1. Examples on Newton-Cotes Quadrature formula</li><li>2. Examples on Trapezoidal Rule</li><li>3. Examples on Simpson's 1/3 Rule</li><li>4. Examples on Simpson's 3/8 Rule</li><li>5. Examples on Linear system of Equations: LU decomposition method (Dolittle's Method and Crout's Method)</li><li>6. Examples on Gauss Seidel Iteration Method</li></ol>	

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### Learning Resources Recommended :

1. All resources recommended for 25\_USMTE508
  2. Practical Question Bank Designed by Department of Mathematics, GJC
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Microsoft Excel
Course Code	25_USMTV510
Class	T.Y.B.Sc.
Semester	V
No. of Credits	4
Nature	Practical
Type	Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	Having a strong command of Excel skills not only enhances chances of securing employment in competitive job markets but also strengthens CV. A comprehensive understanding of Excel helps to tackle complex tasks, analyze data, and make informed decisions, improving the productivity.

Unit No.	Units	No. of Lectures
1	Overview Excel	30
2	Workbook Management	30
3	Formulas & Functions	30
4	Data Analysis	30

## Nomenclature : Microsoft Excel

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. learn the basic mechanics and navigation of an Excel spreadsheet
  2. apply formatting techniques and presentation styles to data
  3. learn printing techniques
  4. learn importing data from web, conditional formatting
  5. learn formulas and use of functions
  6. acquire knowledge of organizing and displaying large amounts and complex data
  7. learn creating charts, graphs
  8. analyze data using various data analysis tools.
- 

### Curriculum :

Unit No.	Title and Learning Points	
1	Overview Excel	30 Lectures
	1.1 Overview, Components, Customizing Excel 1.2 Navigating through Excel, Quick Access toolbar 1.3 Data entry techniques, Basic Cell Formatting 1.4 Working with cells and range, rows and columns 1.5 Find, Replace, Spell check, Undo, Redo etc. 1.6 Autocorrect, Autofill, Autocomplete feature	
2	Workbook Management	30 Lectures
	2.1 File options, Ribbon options, Template, Name Manager 2.2 Page setup, Header and Footer, Printing techniques 2.3 Multiple worksheet options: View, Copy, Move, Hide, Unhide, Tab color 2.4 Save Workbook, Worksheet/workbook protection, unlocking cells 2.5 Importing data from web, Text to columns 2.6 Conditional formatting rules, Validation rules	
3	Formulas & Functions	30 Lectures
	3.1 Formula, Referencing: Absolute, Relative and Mixed 3.2 Linking multiple worksheets 3.3 Defining a function, Types of arguments, entering function 3.4 Logical functions, Database functions, Conditional functions 3.5 Conditional logical functions, Mathematical functions 3.6 Text functions, Date and Time functions	

4	Data Analysis	30 Lectures
	4.1 Sorting data, Filtering data, Remove duplicates 4.2 Insert: Picture, Clipart, Charts: Bar, Column, Pie, etc. 4.3 Subtotals, Pivot Table, Macros 4.4 What If Analysis Tools: Goal Seek, Solver, Scenario Manager	

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**Learning Resources Recommended :**

1. Pratik Shitut; Chasing Excellence
  2. Computer System and Applications, Sheth Publication
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**Evaluation Scheme :**

**A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 20 marks each, 3 Unit tests of 20 marks each and by considering average)	20
Journal	10
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	10

**B. Semester End Evaluation (60 Marks - 3 Hours)**

Comprehensive practical examination of 3-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include practical and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Question based on Unit 1	15
2	Question based on Unit 2	15
3	Question based on Unit 3	15
4	Question based on Unit 4	15

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Name of the Course	Field Project
Course Code	25_USMTF511
Class	T.Y.B.Sc.
Semester	V
No of Credits	4
Nature	Practical
Type	Field Project
Highlight revision specific to employability/ entrepreneurship/ skill development	When learner studies a project course, they learn all the specific techniques, skills and programs which are useful to manage working schedules effectively against a deadline. When you plan your projects well, he can foresee challenges to manage risks, prioritize accordingly and keep his eyes on the end goal. The skills that student get to learn and practice are Analytical thinking and innovation, Active learning, Problem solving, Critical thinking, Leadership and social influence, Reasoning, problem solving and ideation, Resilience, stress tolerance and flexibility.

Unit No.	Units	No. of Hours
1	Field Project	120

## Nomenclature : Field Project

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Enhance interpersonal skills by working in teams
  2. Decide the problem accurately
  3. Learn various methods of collection, analyze of data
  4. Learn use of mathematical concepts for various applications
  5. Make the conclusion from analysis, Suggest the solution
  6. Learn develop new content based on the topics from Mathematics
- 

### Curriculum :

#### Field Project Work - Guidelines

1. A group is of maximum three learners is allowed for a single field project.
  2. Each learner is expected to work for minimum of 120 hours.
  3. A group can opt for in following topics
    - a. Making of Mathematical Models
    - b. Book Review/Translation of Book
    - c. Survey Project
    - d. Creating Mathematical games for school students
    - e. Research Paper Reading
  4. A group is expected to make a report at the end of semester based on the field project they have done in an organization. It should contain the following:
    - a. **Title:** A suitable title giving the idea about what field project the group has done
    - b. **Certificate of Completion:** A certificate issued by the organization confirming the successful completion of the project
    - c. **Declaration:** A statement by group declaring that the report is their original work and acknowledge any assistance or references used.
    - d. **Acknowledgements:** Recognizing individuals or organizations that provided support, guidance or resources during the project
    - e. **Table of Contents:** Providing a clear outline of the report's sections and page numbers
    - f. **Abstract:** A brief overview of the project, its objectives and key findings should be mentioned.
    - g. **Project Details:** Detail description of the project
    - h. **Conclusion:** Summary of the key finding and outcomes of the project
    - i. **References & Appendices:** List of all sources cited in the project report
  5. A group should submit a detailed project report at the end of semester during SEE.
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### Learning Resources Recommended :

1. Field Projects topics available on the various platforms
  2. Research Journals
  3. Material available on various portals
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**Evaluation Scheme :**

**A. Continuous Evaluation (40 Marks)**

Method	Marks
Project Presentation in the mid semester	25
Active participation in project	15

**B. Semester End Evaluation (60 Marks)**

The evaluation of project will be examined by external examiners on following criteria.

Criteria	Marks
Contents of the Project	30
Methodology	10
Presentation	10
Viva	10

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**Revised Syllabus of Courses of  
Bachelor of Science (B.Sc.) Mathematics Programme at Semester VI  
with Effect from the Academic Year 2025-2026**

Course Code	Semester VI	Credits
Major Mandatory		
25_USMTM601	Real Analysis II	2
25_USMTM602	Ring Theory	2
25_USMTM603	Topology of Metric Spaces II	2
25_USMTM604	Practical-7 (Based on 25_USMTM601 & 25_USMTM603)	2
25_USMTM605	Practical-8 (Based on 25_USMTM602)	2
Major Elective (Any one)		
25_USMTE606	Laplace Transform	2
25_USMTE607	Discrete Mathematics II	2
OR		
25_USMTE608	Number Theory	2
25_USMTE609	Practical-Number Theory	2
Vocational Skill Course (VSC)		
25_USMTV610	Python Programming	4
On Job Training		
25_USMTJ611	On Job Training	4
Total Credits		22

Name of the Course	Real Analysis II
Course Code	25_USMTM601
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Real Analysis is a branch of Mathematics that studies the behavior of numbers, functions and sequences. Real analysis is a tool that mathematicians use to ensure their understanding is correct and not based on false assumptions or misconceptions. Some of the properties of real-valued sequences and functions that real analysis studies include: convergence, limits, continuity, smoothness, differentiability, and integrability.

Unit No.	Units	No. of Lectures
1	Sequences of functions	10
2	Series of functions	10
3	Elementary functions	10

## Nomenclature : Real Analysis II

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Solve problems based on convergence, point-wise convergence, uniform convergence of sequences of functions
  2. Distinguish between pointwise convergence and uniform convergence of sequence of functions
  3. Solve problems based on convergence, point-wise convergence, uniform convergence of series of functions
  4. Distinguish between pointwise convergence and uniform convergence of series of functions
  5. Explain the concepts of power series, their radius of convergence and their properties.
  6. Recognize the properties of uniformly convergent sequences of functions like uniform limit theorem, term by term integration and differentiation.
  7. Investigate properties of elementary functions
- 

### Curriculum :

Unit No.	Title and Learning Points
1	Sequences of Functions 10 Lectures
	1.1 Sequences of functions, pointwise convergence, uniform convergence 1.2 Cauchy criteria for uniform convergence 1.3 Interchange of limit and integrations 1.4 Interchange of limit and derivative
2	Series of functions 10 Lectures
	2.1 Series of functions, pointwise convergence, Uniform convergence, Weierstrass M-test 2.2 Term by term Integration, Term by term differentiation 2.3 Power series, radius of convergence
3	Elementary Functions 10 Lectures
	3.1 Exponential function 3.2 Logarithmic function 3.3 Trigonometric functions 3.4 Inverse Trigonometric functions 3.5 Hyperbolic functions

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### Learning Resources Recommended :

1. Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. (1970)
2. Ajitkumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2010

3. Shanti Narayan and P. K. Mittal, A Course of Mathematical Analysis, S. Chand Publication, 2011
  4. D. Somasundaram and B. Choudhari, A first course in Mathematical Analysis, Narosa Publishing House, 1997
  5. Serge Lang, Undergraduate Analysis, Springer International Edition, (2010)
  6. R. G. Bartle and D. R. Scherbert, Introduction to Real Analysis, 4 th Edition, John Wiley, 2012.
  7. Tom M. Apostol; Mathematical Analysis, 2<sup>nd</sup> Edition, Narosa Publishing House
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**Evaluation Scheme :**

**A. Continuous Evaluation (20 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

**B. Semester End Evaluation (30 Marks - 1 Hour)**

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Ring Theory
Course Code	25_USMTM602
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives introduction to Ring Theory which is an extension of Group Theory, wide areas of current research in Mathematics, Computer Science and Mathematical/Theoretical Physics. They have many applications to the study of geometric objects, to topology and in many cases their links to other branches of Algebra are quite well understood.

Unit No.	Units	No. of Lectures
1	Rings	10
2	Ideals and Special Rings	10
3	Factorization	10

## Nomenclature : Ring Theory

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Define fundamental concepts of rings, fields, sub rings, integral domains with suitable examples
  2. Define ideals, Maximal ideal, Prime Ideal, Principal Ideal in a ring and solve examples on it.
  3. Define ring homomorphism and outline related theorems on it.
  4. Describe polynomial rings, Euclidean domain, Principal ideal domain and unique factorization domain and their relationship
  5. Check reducibility of a polynomial by applying various related results
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### Curriculum :

Unit No.	Title and Learning Points
1	Rings 10 Lectures
	1.1 Definition and elementary properties of rings, commutative rings, integral domains and fields with examples 1.2 Units in a ring, The multiplicative group of units in a ring $R$ [and, in particular, the multiplicative group $F^*$ of nonzero elements of a field $F$ ], description of the units in $\mathbb{Z}/n\mathbb{Z}$ , 1.3 Results such as: A finite integral domain is a field. $\mathbb{Z}/p\mathbb{Z}$ , where $p$ is a prime, as an example of a finite field. Characteristic of a ring and examples. Elementary facts such as: The characteristic of an integral domain is either 0 or a prime number. (Note: From here on all rings are assumed to be commutative with unity)
2	Ideals and Special Rings 10 Lectures
	2.1 Ideals in a ring, Sums and products of ideals. Quotient rings. Examples. Prime and Maximal ideals. Characterization of prime ideals and maximal ideals in a commutative ring in terms of their quotient rings. 2.2 Homomorphisms and isomorphism of rings. Kernel and the image of a homomorphism. Fundamental Theorem of homomorphism of a ring. 2.3 Construction of the quotient field of an integral domain (Emphasis on $\mathbb{Z}$ , $\mathbb{Q}$ ). A field contains a subfield isomorphic to $\mathbb{Z}/p\mathbb{Z}$ or $\mathbb{Q}$ . 2.4 Notions of Euclidean domain (ED), principal ideal domain (PID). Examples such as $\mathbb{Z}$ , $\mathbb{Z}[i]$ , & polynomial rings. Relation between these two notions ( $ED \Rightarrow PID$ )
3	Factorization 10 Lectures
	3.1 Divisibility in a ring. Irreducible and prime elements. Examples 3.2 Division algorithm in $F[X]$ (where $F$ is a field). Monic Polynomials. Greatest common divisor of $f(x), g(x) \in F[X]$ (not both 0). Theorem: Given $f(x), g(x) \neq 0$ in $F[X]$ then their greatest common divisor $d(x) \in F[X]$ exists: moreover, $d(x) = a(x)f(x) + b(x)g(x)$ for some $a(x), b(x) \in F[X]$ . 3.3 Irreducible polynomial in $F[X]$ . Examples of irreducible polynomials in $(\mathbb{Z}/p\mathbb{Z})[X]$ ( $p$ prime), Eisenstein Criterion 3.4 Notion of unique factorization domain (UFD). Elementary properties. Example of

$\mathbb{Z}[\sqrt{-5}]$  as a non-UFD. Relation between the three notions ( $ED \Rightarrow PID \Rightarrow UFD$ )

**Learning Resources Recommended :**

1. Israel Herstein; Topics in Algebra; 2<sup>nd</sup> Edition, Wiley Limited, 2<sup>nd</sup> Edition
2. P.B. Bhattacharya, S. K. Jain and S. R. Nagpaul; Abstract Algebra; 2<sup>nd</sup> Ed. Foundation books, New Delhi, 1995
3. N. S. Gopalakrishnan; University Algebra; Wiley Eastern Limited
4. Michael Artin; Algebra; Prentice Hall of India, New Delhi
5. John B. Fraleigh; A First Course in Abstract Algebra; 3<sup>rd</sup> Edition, Narosa
6. Joseph A. Gallian; Contemporary Abstract Algebra; Narosa, New Delhi.

**Evaluation Scheme :**

**A. Continuous Evaluation (20 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

**B. Semester End Evaluation (30 Marks - 1 Hour)**

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Topology of Metric Spaces II
Course Code	25_USMTM603
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Theory
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	This course deals with the metric spaces. It is useful in understanding basic Mathematical concepts of a learner and further applying that to learn higher Mathematics.

Unit No.	Units	No. of Lectures
1	Compact Spaces	10
2	Complete Metric Space	10
3	Connected Spaces	10

## Nomenclature : Topology of Metric Spaces II

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Understand the concept of Compact spaces and solve the problems on it
  2. Understand the concept of Complete metric spaces and solve the problems on it
  3. Understand the concept of Connected spaces and solve the problems on it
- 

### Curriculum :

Unit No.	Title and Learning Points	
1	Compact Spaces	10 Lectures
	1.1 Definition of a compact metric space using open cover 1.2 Examples of compact sets in different metric spaces 1.3 Properties of compact sets: A compact set is closed and bounded 1.4 Every infinite bounded subset of compact metric space has a limit point 1.5 A closed subset of a compact set is compact 1.6 Union and Intersection of Compact sets 1.7 Sequentially compactness property, Continuous image of compact set is compact 1.8 Every continuous function from a compact metric space is uniformly continuous 1.9 Heine-Borel property, Closed and boundedness property, Bolzano-Weierstrass property (Statements only)	
2	Complete Metric Space	10 Lectures
	2.1 Definition and examples of Complete metric spaces 2.2 Subspaces 2.3 Completeness property in subspaces 2.4 Nested Interval theorem in $\mathbb{R}$ 2.5 Cantor's Intersection Theorem 2.6 Applications of Cantor's Intersection Theorem: a) The set of Real Numbers is uncountable b) Density of Rational c) Intermediate Value Theorem	
3	Connected Spaces	10 Lectures
	3.1 Separated sets. 3.2 Connected and disconnected sets. 3.3 Connected and disconnected metric spaces. Results such as: A subset of $\mathbb{R}$ is connected if and only if it is an interval. 3.4 A continuous image of a connected set is connected. 3.5 Characterization of a connected space, viz. a metric space is connected if and only if every continuous function from $X$ to $\{1, -1\}$ is a constant function.	

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**Learning Resources Recommended :**

1. S. Kumaresan; Topology of Metric Spaces.
  2. E. T. Copson; Metric Spaces; Universal Book Stall, New Delhi, 1996.
  3. P. K. Jain, K. Ahmed; Metric Spaces; Narosa, New Delhi, 1996.
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**Evaluation Scheme :****A. Continuous Evaluation (20 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

**B. Semester End Evaluation (30 Marks - 1 Hour)**

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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XX

Name of the Course	Practical-7 (Based on 25_USMTM601 & 25_USMTM603)
Course Code	25_USMTM604
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the courses 25_USMTM601 & 25_USMTM603.

Unit No.	Units	No. of Lectures
1	Problems based on Real Analysis II	20
2	Problems based on Real Analysis II and Compact Spaces	20
3	Problems based on Complete and Connected Spaces	20

**Nomenclature :** Practical-7 (Based on 25\_USMTM601 & 25\_USMTM603)

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**Course Outcomes :**

On successful completion of this course, a learner will be able to:

1. Solve problems based on concepts from Real Analysis II
  2. Solve problems on Concepts from Topology of Metric Spaces
- 

**Curriculum :**

Unit No.	Title and Learning Points	
1	Problems based on Real Analysis II	20 Lectures
	1. Sequence of Functions I 2. Sequences of Functions II 3. Series of Functions I 4. Series of Functions II	
2	Problems based on Real Analysis II and Compact Spaces	20 Lectures
	1. Elementary Functions I 2. Elementary Functions II 3. Compact Spaces I 4. Compact Spaces II	
3	Problems based on Complete and Connected Spaces	20 Lectures
	1. Complete Metric Spaces I 2. Complete Metric Spaces II 3. Connected Spaces I 4. Connected Spaces II	

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**Learning Resources Recommended :**

1. All resources recommended for 25\_USMTM601 & 25\_USMTM603
  2. Practical Question Bank Designed by Department of Mathematics, GJC
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Practical-8 (Based on 25_USMTM602)
Course Code	25_USMTM605
Class	T.Y.B.Sc.
Semester	V
No. of Credits	2
Nature	Practical
Type	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the courses 25_USMTM602.

Unit No.	Units	No. of Lectures
1	Problems based on Rings	20
2	Problems based on Ideals and Special Rings	20
3	Problems based on Factorization	20

**Nomenclature :** Practical-8 (Based on 25\_USMTM602)

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**Course Outcomes :**

On successful completion of this course, a learner will be able to:

1. Solve different examples of rings
  2. Outline and illustrate basic properties and theorem of rings
  3. Illustrate examples on ideals, outline and illustrate theorem on these concepts
  4. Define, illustrate polynomial rings, check irreducibility of polynomials.
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**Curriculum :**

Unit No.	Title and Learning Points
1	Problems based on Rings <span style="float: right;">20 Lectures</span>
	<ol style="list-style-type: none"><li>1. Examples of rings (Commutative and Non-Commutative)</li><li>2. Integral Domains and fields</li><li>3. Units in various Rings, examples on subrings</li><li>4. Determining characteristics of rings</li></ol>
2	Problems based on Ideals and Special Rings <span style="float: right;">20 Lectures</span>
	<ol style="list-style-type: none"><li>1. Prime Ideals and Maximal Ideals, Examples on various Rings</li><li>2. Homomorphism and Isomorphism of rings</li><li>3. Euclidean domains (Examples)</li><li>4. Principal ideal domains (Examples)</li></ol>
3	Problems based on Factorization <span style="float: right;">20 Lectures</span>
	<ol style="list-style-type: none"><li>1. Examples of irreducible element</li><li>2. Examples of prime element</li><li>3. Applications of division algorithm</li><li>4. Irreducibility tests, Applications of Eisenstein's Criterion</li></ol>

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**Learning Resources Recommended :**

1. All resources recommended for 25\_USMTM602
  2. Practical Question Bank Designed by Department of Mathematics, GJC
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Laplace Transform
Course Code	25_USMTE606
Class	T.Y.B.Sc.
Semester	VI
No. of Credits	2
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	This course contains the concepts of Laplace Transform and Inverse Laplace Transform. The course is useful in electronics, electrical fields.

Unit No.	Units	No. of Lectures
1	Laplace Transform-I	10
2	Laplace Transform-II	10
3	Inverse Laplace Transform	10

## Nomenclature : Laplace Transform

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Understand conditions for existence of Laplace Transform
  2. List the Laplace transforms of some standard functions
  3. Solve problems of Laplace Transform using various properties
  4. Calculate Laplace transform of periodic function, error function
  5. Calculate the inverse Laplace Transforms of functions
  6. Apply Laplace and Inverse Laplace Transforms to ODE
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### Curriculum :

Unit No.	Title and Learning Points	
1	Laplace Transform-I	10 Lectures
	1.1 Definition, Existence of Laplace Transform, Functions of exponential order 1.2 Laplace of Some Elementary Functions 1.3 Initial Value Theorem, Final Value Theorem 1.4 Properties: Linearity, Shifting Theorem, Change of Scale Property	
2	Laplace Transform-II	10 Lectures
	2.1 Laplace Transform of Derivatives, Integrals 2.2 Multiplication by powers of t and division by t 2.3 Periodic Function of Laplace Transform, Error Function	
3	Inverse Laplace Transform	10 Lectures
	3.1 Definition, Linearity property, First and Second Translation theorem 3.2 Change of Scale property, Use of Partial fractions 3.3 Inverse Laplace transforms of derivatives and integrals 3.4 Convolution Theorem, Solution of ODE using Transform	

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### Learning Resources Recommended :

1. Baidyanath Patra, An Introduction To Integral Transforms, CPC Press, Taylor & Francis Group
  2. Erwin Kreyszig, Advanced Engineering Mathematics, 8<sup>th</sup> Edition, Authorized reprint by Wiley Dreamtech India
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Discrete Mathematics II
Course Code	25_USMTE607
Class	T.Y.B.Sc.
Semester	VI
No. of Credits	2
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	This course has many applications in areas of Mathematics including Graph Theory, Coding, cryptography and probability. Now a days candidate with knowledge in combinatorics is required for post such as Senior Mathematician, Assistant Professor, Research Scientist.

Unit No.	Units	No. of Lectures
1	Combinatorics-I	20
2	Combinatorics-II	20
3	Posets and Lattices	20

## Nomenclature : Discrete Mathematics II

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Learn fundamental principles, permutation and combination
  2. Solve problems of Inclusion-Exclusion Principle, Pigeonhole principle
  3. Understand concept of Catalan number, Rook Polynomial
  4. Solve recurrence relation using generating function
  5. Understand definition of posets and lattices
  6. Solve problems on posets, lattices and sublattices
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### Curriculum :

Unit No.	Title and Learning Points
1	Combinatorics-I 20 Lectures
	<ol style="list-style-type: none"><li>1. The Fundamental principles, Permutation and Combination</li><li>2. Inclusion-Exclusion Principle and problems</li><li>3. Combinatorial Identities, Forbidden Position Problems</li><li>4. System of Distinct Representatives</li><li>5. Hall's Theorem</li></ol>
2	Combinatorics-II 20 Lectures
	<ol style="list-style-type: none"><li>1. Catalan Number, Sterling Number</li><li>2. Rook Polynomial</li><li>3. Generating Function-Definition, Properties</li><li>4. Solution of Recurrence Relation using Generating function</li><li>5. Solution of non-linear recurrence relation</li></ol>
3	Posets and Lattices 20 Lectures
	<ol style="list-style-type: none"><li>1. Introduction, partially ordered sets</li><li>2. Product and Lexicographic Order</li><li>3. Hasse Diagram</li><li>4. Lattice, Lattice as Algebraic System</li><li>5. Principle of duality, Sublattices</li></ol>

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### Learning Resources Recommended :

1. A Textbook of Discrete Mathematics by Swapan Kumar Sarkar, S. Chand Publication
  2. Combinatorial Techniques by Sharad S. Sane, Hindustan Book Agency
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Number Theory
Course Code	25_USMTE608
Class	T.Y.B.Sc.
Semester	VI
No. of Credits	2
Nature	Theory
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	The Knowledge from number theory is applied in different computer science branches, e.g., data structures, sorting algorithms, and optimization techniques.

Unit No.	Units	No. of Lectures
1	Unique factorization in $Z$ and Congruence	10
2	Quadratic Reciprocity	10
3	Diophantine Equations	10

## Nomenclature : Number Theory

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Understand unique factorization in  $\mathbb{Z}$
  2. Acquire knowledge of arithmetic functions such as Mobius, Divisor
  3. Know the concepts quadratic residues, Gauss Lemma
  4. Learn Linear Diophantine equations
  5. Understand Legendre's theorem, Sophie Germain's theorem
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### Curriculum :

Unit No.	Title and Learning Points	
1	Unique factorization & Congruence	10 Lectures
	1.1 Divisibility in Integers, Primes, Division Algorithm, G.C.D 1.2 Euclid's Algorithm, Fundamental Theorem of Arithmetic 1.3 Infinitely many primes in $\mathbb{Z}$ , Some Arithmetic Functions-Euler Function $\varphi(n)$ , Divisor Function $\vartheta(n)$ , Mobius Function $\mu(n)$ 1.4 Mobius Inversion Theorem, Congruence in $\mathbb{Z}$ , Congruence Classes, Complete Set of Residues, The Congruence $ax \equiv b(m)$ , Eulers Theorem	
2	Quadratic Reciprocity	10 Lectures
	2.1 Fermat's Little Theorem, Chinese Remainder Theorem 2.2 Quadratic Residues, Legendre Symbol, Gauss Lemma 2.3 Law of Quadratic Reciprocity, Jacobi Symbol 2.4 Proof of the Law of Quadratic Reciprocity	
3	Diophantine Equations	10 Lectures
	3.1 Linear Diophantine Equations, Solutions of $y^3 = px + 2$ , $x^2 + y^2 = z^2$ and $x^3 + py^3 + p^2z^3 = 0$ 3.2 The method of descent, Legendre's Theorem, Sophie Germain's Theorem 3.3 Pell's Equation, Sum of two squares	

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### Learning Resources Recommended :

1. A Classical Introduction to Modern Number Theory (2nd Edition)- Ken neth Ireland and Michael Rosen, Springer (Graduate texts in Mathematics)
  2. An Introduction to the Theory of Numbers- G. H. Hardy and E. M. Wright, Oxford University Press.
  3. Elementary Number Theory- David M. Burton, Universal Book Stall, New Delhi
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 2 Unit tests of 10 marks each, 3 Unit tests of 10 marks each and by considering average)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	I	10
2	II	10
3	III	10

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Name of the Course	Practical-Number Theory
Course Code	25_USMTE609
Class	T.Y.B.Sc.
Semester	VI
No. of Credits	2
Nature	Practical
Type	Major Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching Mathematics allows learners to explore the material in a more hands-on manner. This course allows learners to apply problem-solving techniques and gain an understanding of the application of the course 25_USMT608

Unit No.	Units	No. of Lectures
1	Exercise Type-I	20
2	Exercise Type-II	20
3	Exercise Type-III	20

**Nomenclature : Practical-Number Theory**

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**Course Outcomes :**

On successful completion of this course, a learner will be able to:

1. Solve problems on concepts from Number Theory
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**Curriculum :**

Unit No.	Title and Learning Points	
1	Exercise-Type-I	20 Lectures
	1. Examples on Divisibility in integers 2. Examples on Division Algorithm 3. Problems on Divisor function, Mobius Function	
2	Exercise-Type-II	20 Lectures
	1. Problems on Fermat's Little Theorem 2. Problems on Chinese Remainder Theorem 3. Problems on Quadratic Reciprocity	
3	Exercise-Type-III	20 Lectures
	1. Problems on Linear Diophantine Equations 2. Problems on Sums of Two squares 3. Examples on Algebraic Numbers and Algebraic Integers	

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**Learning Resources Recommended :**

1. All resources recommended for 25\_USMTE608
  2. Practical Question Bank Designed by Department of Mathematics, GJC
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## Evaluation Scheme :

### A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	15
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

### B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

#### Question Paper Pattern :

Sr. No.	Head	Marks
1	Question Paper	
	Q1) MCQ questions based on a Units 1,2,3	05
	Q2) Descriptive question based on Unit 1	05
	Q3) Descriptive question based on Unit 2	05
	Q4) Descriptive question based on Unit 3	05
2	Viva	10

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Name of the Course	Python Programming
Course Code	25_USMTV610
Class	T.Y.B.Sc.
Semester	VI
No. of Credits	4
Nature	Practical
Type	Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	Python developers can choose their career path to highly paid jobs such as Machine Learning Engineer, Data Scientist, Big Data Engineer, Full-Stack Web Developer, and DevOps engineer. Language can be used for many mathematical applications, including scientific computing and data analysis.

Unit No.	Units	No. of Lectures
1	Python 3.x	30
2	Functions & Modules	30
3	Looping & File Processing	30
4	Applications	30

## Nomenclature : Python Programming

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. learn the operators in Python
  2. learn data types in Python
  3. acquire knowledge of functions, User Defined functions
  4. learn exception handling
  5. learn looping, file processing
  6. apply python for various applications
- 

### Curriculum :

Unit No.	Title and Learning Points	
1	Python 3.x	30 Lectures
	1.1 Introduction, History, Features, Installation 1.2 Variables, Identifiers, Keywords, Comments 1.3 Operators: Arithmetic, Comparison, Logical, Membership 1.4 Python Standard Data Types: Strings, List, Tuples, Dictionaries 1.5 String, List, Dictionary Methods	
2	Functions & Modules	30 Lectures
	2.1 Built in functions, Math Functions 2.2 Need of Functions, User Defined Functions 2.3 Parameters and Arguments, Boolean Function, Recursive Function 2.4 Concept of modularization, Modules: Importance, Importing, Built In 2.5 Exception Handling, Random Numbers	
3	Looping & File Processing	30 Lectures
	3.1 Conditional Statements: If, If-Else, If-elif-else 3.2 Control statements: Break, Continue, Pass 3.3 Looping: For, While, nested loops 3.4 Concept of files, File opening in various modes and closing of a file 3.5 Writing onto a file, File handling functions: Open(), close(), read()	
4	Applications	30 Lectures
	4.1 Graph Plotting using matplotlib 4.2 Sympy Library functions: Symbol, Factor, Expand, Simplify, Solve 4.3 Excel file handling using xlrd, xlwt, pyexcel 4.4 GUI Development using Tkinter widgets 4.5 Telegram bot development using telepot	

**Learning Resources Recommended :**

1. Kenneth A Lambert; Fundamentals of Python First programs, 2nd edition, Cengage Learning India
  2. E. Balgurusamy; Problem solving and Python programming, Tata McGraw Hill
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**Evaluation Scheme :****A. Continuous Evaluation (40 Marks)**

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 20 marks / 2 Unit tests of 20 marks each, 3 Unit tests of 20 marks each and by considering average)	20
Journal	10
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	10

**B. Semester End Evaluation (60 Marks - 3 Hours)**

Comprehensive practical examination of 3-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include practical and descriptive type questions.

## Question Paper Pattern :

Question No.	Unit	Marks
1	Question based on Unit 1	15
2	Question based on Unit 2	15
3	Question based on Unit 3	15
4	Question based on Unit 4	15

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Name of the Course	On Job Training
Course Code	25_USMTJ611
Class	T.Y.B.Sc.
Semester	VI
No of Credits	4
Nature	Practical
Type	On Job Training
Highlight revision specific to employability/ entrepreneurship/ skill development	On Job Training are a convenient way to gain some work experience while studying. It is an opportunity to apply theoretical knowledge learned in class to real-world settings. Practical training enables students to gain hands-on skills and industry-specific knowledge. Interns can learn about the day-to-day operations of a specific profession, which can help them progress in their career goals.

Unit No.	Units	No. of Hours
1	On Job Training at an Organization	120
2	Report writing in college	---

## Nomenclature : On Job Training

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### Course Outcomes :

On successful completion of this course, a learner will be able to:

1. Learn working ethics in an organization
  2. Learn life skills of working in an industry/institution/company
  3. Gain exposure to real-world insights and apply theoretical knowledge to practical situations
  4. Acquire knowledge from mathematics from the working in respective organization.
  5. Build industry connections and networking opportunities
- 

### Curriculum :

#### On Job Training Work-Guidelines (120 Hours)

1. Each learner shall undertake On Job Training in an organization/Industry/Educational Institute for 120 hours.
2. Student can opt from following topics
  - a. Content Development for School Section
  - b. E-Content Development for Social Media
  - c. Teaching at various Institutes
3. A student is expected to find OJT by himself or herself. However, the institution should assist their students in getting OJT in good organizations. (undertaking to be submitted)
4. The home institution cannot be taken as the place for OJT
5. A student is expected to make a report at the end of semester based on the OJT he or she has done in an organization. It should contain the following:
  - a. **Title Page:** A suitable title giving the idea about what work the student has performed during the OJT
  - b. **Certificate of Completion:** A certificate confirming the successful completion of OJT
  - c. **Declaration:** A statement by the student declaring that the report is their original work and acknowledging any assistance or reference used.
  - d. **Acknowledgement:** Recognizing individual or organizations that provided support, guidance or resources during the training
  - e. **Table of Contents:** Providing a clear outline of the report's sections and page numbers.
  - f. **Description of the organization:** A small description of the organization where the student has interned.
  - g. **Description of work allotted and done by the intern:** A detailed description of the work allotted and actual work performed by the intern during the internship period.
  - h. **Self-Assessment:** A self-assessment by the intern on what he or she has learnt during the internship period.
  - i. **Conclusion:** A brief overview of intern's experience and suggestions to bridge the gap between theory and practice.
  - j. **Relieving Letter from organization:** A letter by employer confirming that intern has completed work of 120 hours.

**Evaluation Scheme :**

**A. Continuous Evaluation (40 Marks)**

Method	Marks
Report Presentation in the mid semester	20
Attendance and active participation at organization (By Employer)	20

**B. Semester End Evaluation (60 Marks)**

The evaluation of internship will be examined by external examiners on following criteria.

Criteria	Marks
Evaluation form by employer	40
Report	10
Presentation	05
Viva	05

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Name and Signature: Dr. Diwakar P. Karwanje  
Chairman of BoS of Mathematics