



Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjhunwala College
of Arts, Science & Commerce
(Empowered Autonomous Status)

Affiliated to
UNIVERSITY OF MUMBAI
Syllabus for the T.Y.B.Sc. (under NEP)
Program: B.Sc. Mathematics
Program Code: RJSUMAT
Course: Discipline Specific Courses
Course Code: RJDSCMAT& RJDSCMATP

**(REVISED in 2024-2025 in alignment with the NEP 2020 facilitating the inter-and
multidisciplinary learning and multiple entry and exit of the students)**

(CBCS 2025-2026)

THE PREAMBLE

Why Mathematics?

Mathematics is the language of all Science, Engineering, and Technology. Mathematics is considered the queen of sciences. Without Mathematics, there can be neither science nor engineering. Mathematics occupies a crucial and unique role in human societies and represents a strategic key in the development of the whole of mankind. Mathematics is around us. It is present in different forms; the list is just endless if one goes on to note down the situations when our computational skill or more specifically, simple mathematics comes to play a role, almost every next moment we do the simple calculations at the back of our mind. Of course, these are all done pretty unconsciously without a thought being spared for the use of mathematics on all such occasions. Mathematics helps the man to give exact interpretation to his ideas and conclusions. It is the numerical and calculation part of man's life and knowledge. It plays a predominant role in our everyday life and it has become an indispensable factor for the progress of our present-day world. Further, in modern times, the adoption of mathematical methods in the social, medical and physical sciences has expanded rapidly, confirming mathematics as an indispensable part of undergraduate curricula and creating a great demand for mathematical training. Much of the demand stems directly from the need for mathematical modeling of phenomena. Such modeling is basic to all engineering, plays a vital role in all physical sciences and contributes significantly to the biological sciences, medicine, psychology, economics and commerce. The numerous applications of the subject in almost every field makes mathematics the most versatile subject choice.

Why Mathematics at R J College?

The department of Mathematics of R J College is the department as old as the college itself. It started in 1963, the inception year of the college and since then has remained as the center of academic activities for the subject. With a legacy of more than 6 decades, today the department offers undergraduate programs in the subject of mathematics with more than one discipline-specific elective paper and is affiliated to, and recognized by the University of Mumbai. As an applied component in the final year, mathematics students learn computer programming languages like Java, SQL, and python along with system analysis. Series of guest lectures, Problem-solving sessions, lecture-based learning, bridge courses, institute visits etc. motivate students to explore more in terms of applications of the subject. Under autonomy, the department has made the curriculum more robust by incorporating skill-based learning and value-added course that imparts practical knowledge of the subject to the students. Every year the department organizes a seminar competition on the theme 'Applications of Mathematics' in various areas. Department of Mathematics also runs a value-added course in a year and is able to attract students from other disciplines of science enrolling for these courses. Department of mathematics has received funding from the Department of Biotechnology (DBT), New Delhi to further strengthen our hands in being

able to provide hands-on training to the students to satisfy their curiosity and inculcate research aptitude.

Our Curriculum, Your Strength

The syllabus for mathematics for the total six semesters is meticulously designed so as to make students understand the diversity of subject. From learning elementary calculus and basic algebra, students move on to applied aspects of the subject in terms of Real analysis, multivariable calculus, Complex analysis, abstract algebra. Specialized training in differential equations, numerical methods is a part of the learning process. The teaching staffs of the department of mathematics are highly qualified and are dedicated to their subjects giving a friendly environment for the students. The department always aims to develop skills, ideas and overall progress of the students. Many of our students participate and get awards in various activities like MTTS program, Madhava Mathematics competition and other competitive exams. The environment of the department is very friendly which is useful for the students coming from other colleges also.

CREDIT STRUCTURE FOR SEMESTER V

Course	Nomenclature	Credits	Topics
DISCIPLINE SPECIFIC COURSES			
RJDSCMAT351	Algebra V	03	1. Linear Algebra-V (Quotient Spaces, Orthogonal Linear Transformations and Characteristic polynomials) 2. Linear Algebra-VI (Eigenvalues, eigenvectors and Diagonalisation) 3. Group theory -I (Groups and Subgroups)
RJDSCMAT352	Multivariable Calculus	03	1. Partial Differentiation 2. Total Differentiation 3. Multiple Integrals
RJDSCMAT353	Metric Spaces -I	03	1. Metric Spaces, Open Sets and Closed Sets 2. Sequences and Limit Points 3. Continuous Functions
RJDSCMATP351	Mathematics Practical	03	1. Algebra V 2. Multivariable Calculus 3. Metric Spaces -I

CREDIT STRUCTURE FOR SEMESTER VI

Course	Nomenclature	Credits	Topics
DISCIPLINE SPECIFIC COURSES			
RJDSCMAT361	Algebra VI	03	1. Group Theory - II (Cyclic groups and subgroups) 2. Group Theory-III (Cosets, Homomorphism, Isomorphism) 3. Group Theory-IV (Quotient groups, Isomorphism theorems and Direct product of groups)
RJDSCMAT362	Basic Complex Analysis	03	1. Analytic functions 2. Complex integration 3. Complex power series
RJDSCMAT363	Metric Spaces -II	03	1. Compact Sets 2. Connected Sets 3. Sequence and Series of Functions
RJDSCMATP361	Mathematics Practical	03	1. Algebra VI 2. Basic Complex Analysis 3. Metric Spaces - II

T.Y.B.Sc. Semester V Mathematics (Major) Syllabus

Discipline Specific Course: Paper 1

Title: Algebra V

Course code: RJDSCMAT351

Credits: 03

UNIT I: Linear Algebra- V

(Quotient Spaces, Orthogonal Linear Transformations and Characteristic Polynomials)
[15 hours]

Cosets, Quotient Spaces, First Isomorphism theorem of real vector spaces Dimension and basis of the quotient space $\frac{V}{W}$, when V is finite dimensional.

Orthogonal transformations, Reflections with respect to a hyperplane, orthogonal transformation of $\mathbb{R}^2$.

Characteristic polynomial of an $n \times n$ real matrix. Cayley Hamilton Theorem and its Applications.

UNIT II: Linear Algebra- VI (Eigenvalues, eigenvectors, and Diagonalisation) [15 hours]

Eigenvalues and eigenvectors of a linear transformation of a finite dimensional real vector space to itself and examples, Eigenvalues and Eigenvectors of $n \times n$ real matrices. Theorems on eigenvalues and eigenvectors.

The characteristic polynomial of a linear transformation of a finite dimensional real vector space to itself. Similar matrices, Relation with change of basis, Invariance of the characteristic polynomial and (hence of the) eigenvalues of similar matrices.

Geometric multiplicity and Algebraic multiplicity of eigenvalues of an $n \times n$ real matrix. Diagonalizable matrix. Diagonalisation of a linear transformation of a finite dimensional real vector space to itself.

UNIT III: Group Theory – I (Groups and Subgroups)

[15 hours]

Definition of a group, abelian group. Various examples of groups. Order of a group, finite groups, infinite groups. Integral powers and order of elements in a group with examples. Definition of Subgroups and examples.

Recommended Books:

1. Serge Lang, Introduction to Linear Algebra, Second Edition, Springer. 1986
2. S. Kumaresan, Linear Algebra, A Geometric Approach, Prentice Hall of India, Pvt. Ltd, 2000.
2. W. Keith Nicholson, Linear Algebra with Applications, Lyryx Learning Team.
3. A. Ramachandra Rao and P. Bhima Sankaran: Linear Algebra, Hindustan Book Agency, 2000
4. J. Gallian. Contemporary Abstract Algebra. Narosa, New Delhi.
5. I.N. Herstein, Topics in Algebra, Second edition, Wiley Eastern Limited.
6. J.B. Fraleigh, A first course in Abstract Algebra, Third edition, Narosa, New Delhi.

SEMESTER	V DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	ALGEBRA-V
COURSE CODE	RJDSCMAT351
CREDITS	03
DURATION	45 HOURS

LEARNING OBJECTIVES	
1	Learn to find basis and dimensions of a quotient space.
2	Learn to find eigenvalues and eigenspaces of the endomorphism.
3	Detailed study of Group theory with examples.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	Cosets, Quotient Spaces and orthogonal transformations	1	3
CO2	Eigen values and Eigen vectors Diagonalizable matrix.	1,3	3
CO3	Groups and its properties, subgroups.	1,3,4	2,3

Discipline Specific Course: Paper 2

Title: Multivariable Calculus

Course code: RJDSCMAT352

Credits: 03

UNIT 1: Partial Differentiation

[15 hours]

Directional derivatives and partial derivatives of scalar fields, higher order partial derivatives, gradient of a scalar field, mean value theorem for derivatives of scalar fields, chain rule for derivatives of scalar fields, homogeneous functions and Euler's theorem, Jacobian, properties of Jacobian, Jacobian of implicit functions, partial derivatives of implicit functions by Jacobian.

UNIT 2: Total Differentiation

[15 hours]

Differentiability of a scalar field, the total derivative and its properties, differentiability of scalar field implies its continuity, necessary condition for differentiability, sufficient condition for differentiability.

Total derivative of vector fields, differentiability in terms of linear transformation, chain rule for derivatives of vector fields, Taylor's formula for functions of two variables, linear approximation, quadratic approximation, extreme values, saddle points, first derivative test, second partial derivative test, method of Lagrange's Multipliers.

UNIT 3: Multiple Integrals

[15 hours]

Definition of double (resp: triple) integral of a function and bounded on a rectangle (resp: box) and arbitrary bounded domain. Geometric interpretation as area and volume. Basic properties of double and triple integrals such as:

- i. Integrability of the sums, scalar multiples, products, and (under suitable conditions) quotients of integrable functions.
- ii. Integrability of continuous functions.
- iii. Domain additivity of the integral. Integrability and the integral over arbitrary bounded domains.

Change of variables formula. Polar, cylindrical and spherical coordinates, and integration using these coordinates, Leibniz rule, Fubini theorem over rectangles and any closed bounded sets, Iterated integrals.

Reference books:

1. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis, third edition, John Wiley & Sons, Inc.
2. S. C. Malik, Savita Arora, Mathematical Analysis, third edition, New Age International Publishers, India.
3. M. Thamban Nair, Calculus of One Variable, student edition, Ane Books Pvt. Ltd.
4. Kenneth A. Ross, Elementary Analysis: The Theory of Calculus, International edition, Springer.

SEMESTER	V DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	MULTIVARIABLE CALCULUS
COURSE CODE	RJDSCMAT352
CREDITS	03
DURATION	45 HOURS

LEARNING OBJECTIVES	
1	Various definitions of derivatives of multivariable functions.
2	Applications to find extreme values.
3	Calculus for scalar and vector fields.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	To study directional derivatives, partial derivatives and Mean value theorem for derivatives of scalar fields.	1	3
CO2	To define total derivative as a linear transformation and to discuss relations between directional derivatives, partial derivatives and total derivatives.	1,3	3
CO3	To study double and triple integrals	1,3	1,4

Discipline Specific Course: Paper 3

Title: Metric Spaces-I

Course code: RJDSCMAT353

Credits: 03

UNIT 1: Metric spaces, open sets and closed sets [15 hours]

Definition; examples of metric spaces $\mathbb{R}, \mathbb{R}^2, \mathbb{R}^n$ with Euclidean, sup and sum metric; Normed linear spaces; Examples: the spaces of sequences, the spaces of continuous functions. Discrete metric space, Finite metric spaces.

Metric subspaces, Product of two metric spaces. Open balls, closed balls, open sets, closed sets in a metric space. Hausdorff property. Interior of a set. Equivalent metrics and norms. Bounded Sets.

UNIT 2: Sequences and limit points [15 hours]

Sequences, Convergent sequence, Cauchy sequence, and subsequences in metric space. Limit point of a set, a set is closed iff it contains all its limit points, Characterization of limit points in terms of sequences.

Closure of a set and boundary of a set. Dense subsets in a metric space and Separability. Distance of a point from a set, distance between two sets, diameter of a set in a metric space. Complete metric spaces, Cantor's intersection theorem.

UNIT 3: Continuous functions [15 hours]

Sequential definition of continuity of a function from one metric space to another. Characterization of continuity in terms of: epsilon-delta definition; open sets; closed sets. Algebra of continuous real valued functions on a metric space. Continuity of composition of continuous function. Uniform continuity in a metric space, definition and examples. Contraction mapping, Banach's fixed-point theorem.

Recommended Books:

1. S. Kumaresan, Topology of Metric spaces, Second Edition, Narosa, New Delhi, 2011.
2. R.R. Goldberg, Methods of Real Analysis, Oxford and International Book House (IBH) Publishers, New Delhi, 1970.

Reference Books:

3. M. Ó Searcóid, Metric Spaces, Springer-Verlag, London, 2007.
4. E. T. Copson, Metric Spaces, Universal Book Stall, New Delhi, 1990.
5. Robert Bartle and Donald R. Sherbert, Introduction to Real Analysis, Fourth Edition, John Wiley and Sons, 2011.
6. Ajit Kumar, S. Kumaresan, Basic course in Real Analysis, CRC press, 2014.
7. G.F. Simmons, Introduction to Topology and Modern Analysis, Indian Edition, McGraw-Hill Education, India, 2017.
8. W. A. Sutherland, Introduction to metric & topological spaces, Second Edition, OUP, UK, 2009.
9. T. Apostol, Mathematical Analysis, Second edition, Narosa, New Delhi, 2002.
10. P. K. Jain, K. Ahmed, Metric Spaces, Second Edition, Narosa, New Delhi, 2004.
11. W. Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill, 1976.
12. D. Somasundaram, B. Choudhary, A first Course in Mathematical Analysis, Narosa, New Delhi, 1996.

SEMESTER	V DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	METRIC SPACES-I
COURSE CODE	RJDSCMAT353
CREDITS	03
DURATION	45 HOURS

LEARNING OBJECTIVES	
1	Knowledge of metric spaces, normed linear spaces
2	Concepts of open sets and closed sets, limit points, closure of a set
3	Understanding of uniform continuity

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	To learn various examples of metric spaces, open sets, closed sets	1	3
CO2	To know convergence of a sequence, closure of a set and its various properties	1,3	3
CO3	To understand various characterization of continuous functions	1,3	1,4

Discipline Specific Course: Practical

Title: Mathematics Practical

Course code: RJDSCMATP351

Credits: 03

Practicals based on Algebra V:

1. Quotient Space and Orthogonal Transformations.
2. Cayley-Hamilton Theorem and its applications.
3. Eigenvalues and Eigenvectors.
4. Similar matrices and Diagonalisation.
5. Groups and its properties.
6. Subgroups and order of elements in a group.

Practicals based on Multivariable Calculus:

1. Problems based on directional derivatives, partial derivatives, and mean value theorem, Euler's theorem for homogeneous functions.
2. Problems based on Jacobian and its applications.
3. Problems based on total derivative of scalar and vector fields, and chain rule for derivative of vector fields.
4. Problems based on linear and quadratic approximations, extreme values, saddle points, and method of Lagrange's multipliers.
5. Problems based on double integrals.
6. Problems based on triple integrals.

Practicals based on Metric Spaces-I:

1. Example of metric spaces, normed linear spaces.
2. Open & closed sets in metric spaces, interior of a set.
3. Sequences in a metric space, Limit points, Closure of a set.
4. Dense sets, separability, distance between two sets.
5. Continuity in a metric space.
6. Uniform continuity, contraction maps.

SEMESTER	V DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	MATHEMATICS PRACTICAL
COURSE CODE	RJDSCMATP351
CREDITS	03
DURATION	90 HOURS

LEARNING OBJECTIVES	
1	Learning concepts of quotient spaces, orthogonal linear transformations, groups and subgroups.
2	Learning concepts of partial and total differentiation, and multiple integrals.
3	Learning metric spaces, open sets and closed sets, limit points.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	Apply the knowledge of quotient spaces, groups, and subgroups	1,2,3	3
CO2	Understand applying partial and total differentiation, and multiple integrals	1,2,3	3
CO3	Understand the concept of metric space, open set, closed set, limit points	1,2,3	3

T.Y.B.Sc. Semester VI Mathematics Syllabus

Discipline Specific Course: Paper 1

Title: Algebra-VI

Course code: RJDSCMAT361

Credits: 03

UNIT I: Group Theory – II (Cyclic groups and subgroups) [15 hours]

Cyclic groups and examples. Cyclic subgroups of a group and examples. Finite cyclic groups, infinite cyclic groups and their generators. Properties of cyclic group and subgroups.

UNIT II: Group Theory – III (Cosets, Homomorphism, Isomorphism) [15 hours]

Definition of Coset and their properties, Lagrange's theorem, Fermat's little theorem, Euler's theorem. Group homomorphisms, isomorphisms and automorphisms. Kernel and image of a group homomorphism. Properties of group homomorphism and isomorphism.

UNIT III: Group Theory – IV

(Quotient groups, Isomorphism theorems and Direct product of groups) [15 hours]

Definition of Normal subgroups of a group and examples. Center of a group, Quotient group. First Isomorphism theorem (or Fundamental Theorem of homomorphisms of groups), Second Isomorphism theorem, third Isomorphism theorem, Cayley's theorem, External direct product of a group: Definition, Properties, Order of an element and criterion for external direct product to be cyclic.

Recommended Books:

1. J. Gallian. Contemporary Abstract Algebra. Narosa, New Delhi.
2. J.B. Fraleigh, A first course in Abstract Algebra, Third edition, Narosa, New Delhi.
3. M. Artin, Algebra, Prentice Hall of India, New Delhi.
4. T. W. Hungerford, Algebra, Springer.
5. S. D. Adhikari. An introduction to Commutative Algebra and Number theory, Narosa Publishing House.
6. N.S. Gopalkrishnan, University Algebra, Wiley Eastern Limited.
7. P.B. Bhattacharya, S.K. Jain, S. Nagpaul, Abstract Algebra, Second edition
8. D. Dummit, R. Foote, Abstract Algebra, John Wiley & Sons, Inc.
9. I.S. Luther, I.B.S. Passi, Algebra - Vol. I, Narosa Publishing House.
10. I.N. Herstein, Topics in Algebra, Second edition, Wiley Eastern Limited.

SEMESTER	VI DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	ALGEBRA-VI
COURSE CODE	RJDSCMAT361
CREDITS	03
DURATION	45 HOURS

LEARNING OBJECTIVES	
1	Learn to find generators of a cyclic group
2	Learn to find cosets of a subgroup. Learn to find kernel and Image of group homomorphism
3	Learn to find quotient groups. Learn to check direct product of group is cyclic.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	Know cyclic groups and subgroups.	1	3
CO2	Understand cosets, homomorphism and isomorphism of groups	1,3	3
CO3	Understand Normal groups, Quotient groups and Isomorphism theorems of groups. External direct product of groups	1,3	2,3

Discipline Specific Course: Paper 2

Title: Basic Complex Analysis

Course code: RJDSCMAT362

Credits: 03

UNIT 1: Analytic Functions

[15 hours]

Limit at a point, theorems on limits, convergence of sequences of complex numbers and results using properties of real sequences, complex functions, real and imaginary part of complex functions, continuity at a point and algebra of continuous functions, derivative of complex functions; comparison between differentiability in real and complex sense, Cauchy-Riemann equations, sufficient conditions for differentiability, analytic functions and their properties, algebra of analytic functions, chain rule, harmonic functions and harmonic conjugate.

UNIT 2: Complex Integration

[15 hours]

Exponential function, logarithmic function, trigonometric functions, hyperbolic functions, and their properties, linear fractional transformations.

Evaluating the contour integral of complex functions, Cauchy's integral theorem, Cauchy-Goursat theorem, Morera theorem, The Cauchy integral formula, consequences of the Cauchy integral formula, derivative of analytic functions, Liouville theorem, application to the fundamental theorem of algebra, maximum modulus theorem.

UNIT 3: Complex Power Series

[15 hours]

Taylor theorem for analytic functions, power series of complex numbers and related results, radius of convergence, disc of convergence, uniqueness of series representation, Laurent series, Laurent theorem, definition of isolated singularity, type of isolated singularities viz., removable, pole and essential defined using Laurent series expansion, Cauchy residue theorem and calculation of residue, applications of residues.

Recommended Books:

1. James Ward Brown, Ruel V. Churchill, Complex variables and applications, seventh edition, McGraw Hill
2. Dennis G. Zill, Patrick D. Shanahan, Complex Analysis A First Course with Applications, third edition, Jones & Bartlett

Reference books:

1. Alan Jeffrey, Complex Analysis and Applications, second edition, CRC Press.
2. H.S. Kasana, Complex Variables Theory and Applications, second edition, PHI Learning Private Ltd.
3. S. Kumaresan, A Pathway to Complex Analysis, first edition, Techno World, India
4. Jerrold E. Marsden, Michael Hoffman, Basic Complex Analysis, third edition, W.H. Freeman, New York.

5. Reinhold Remmert, Theory of Complex Functions, Springer.
6. Richard A. Silverman, Introductory Complex Analysis, Prentice-Hall, Inc.

SEMESTER	VI DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	BASIC COMPLEX ANALYSIS
COURSE CODE	RJDSCMAT362
CREDITS	03
DURATION	45 HOURS

LEARNING OBJECTIVES	
1	To be able to identify complex differentiability, analyticity of complex functions using definition and C-R equations
2	Cauchy theory of complex integration and its applications
3	To understand complex power series and types of singularities

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	To study limit and continuity, differentiability and analyticity of complex functions	1	3,4
CO2	To evaluate complex integration using Cauchy integral formula	1,3	3
CO3	To learn power series of complex numbers including Taylor's series and Laurent's series and different types of singularities	1,3	2,3

Discipline Specific Course: Paper 3

Title: Metric Spaces-II

Course code: RJDSCMAT363

Credits: 03

UNIT 1: Compact sets

[15 hours]

Definition of compact metric space using open cover, examples of compact sets in different metric spaces, sequentially compact metric space, Bolzano-Weierstrass property.

Properties of compact sets: A compact set is closed and bounded. Every infinite bounded subset of compact metric space has a limit point. A compact set has Bolzano-Weierstrass property. A compact set is sequentially compact. Continuous maps on compact sets.

A closed subset of a compact set is compact. Union and Intersection of Compact sets. Equivalent statements for compact sets in $\mathbb{R}^n$: Sequentially compactness property, Heine-Borel property, Bolzano-Weierstrass property.

UNIT 2: Connected sets

[15 hours]

Separated sets, connected metric spaces, connected subsets of a metric space, Connected subsets of $\mathbb{R}$. Continuous image of a connected set is connected. Two-valued functions and connected sets. Connected components.

Path connectedness in $\mathbb{R}^n$, continuous image of path connected set is path connected. A path connected subset of $\mathbb{R}^n$ is connected, convex sets are path connected.

UNIT 3: Sequence and series of functions [15 hours]

Sequence of functions - pointwise and uniform convergence of sequences of real-valued functions. Series of functions, convergence of series of functions, Weierstrass M-test, examples. Properties of uniform convergence: Continuity of the uniform limit of a sequence of continuous functions, conditions under which integral and the derivative of sequence of functions converge to the integral and derivative of uniform limit on a closed and bounded interval, consequences of these properties for series of functions, term by term differentiation and integration.

Power series in x centered at origin and at some point in $\mathbb{R}$, radius of convergence, region (interval) of convergence, uniform convergence, term-by-term differentiation and integration of power series, uniqueness of series representation.

Recommended Books:

1. S. Kumaresan, Topology of Metric spaces, Second Edition, Narosa, New Delhi, 2011.
2. Ajit Kumar, S. Kumaresan, Basic course in Real Analysis, CRC press, 2014.
3. R.R. Goldberg, Methods of Real Analysis, Oxford and International Book House (IBH) Publishers, New Delhi, 1970.

Reference Books:

1. M. Ó Searcóid, Metric Spaces, Springer-Verlag, London, 2007.
2. E. T. Copson, Metric Spaces, Universal Book Stall, New Delhi, 1990.
3. Robert Bartle and Donald R. Sherbert, Introduction to Real Analysis, Fourth Edition, John Wiley and Sons, 2011.
4. G.F. Simmons, Introduction to Topology and Modern Analysis, Indian Edition, McGraw-Hill Education, India, 2017.
5. W. A. Sutherland, Introduction to metric & topological spaces, Second Edition, OUP, UK, 2009.
6. T. Apostol, Mathematical Analysis, Second edition, Narosa, New Delhi, 2002.
7. P. K. Jain, K. Ahmed, Metric Spaces, Second Edition, Narosa, New Delhi, 2004.
8. W. Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill, 1976.
9. D. Somasundaram, B. Choudhary, A first Course in Mathematical Analysis, Narosa, New Delhi, 1996.

SEMESTER	VI DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	METRIC SPACES-II
COURSE CODE	RJDSCMAT363
CREDITS	03
DURATION	45 HOURS

LEARNING OBJECTIVES	
1	To be able to describe compact sets and its properties
2	To be able to describe connected sets and its properties
3	Learning of sequence and series of functions and their consequences on continuity, differentiability and integrability

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	study various characterization of compact sets in a metric space	1,4	3,4
CO2	understand connected sets in a metric space	1,3,4	3
CO3	study pointwise and uniform convergence of sequence and series of functions	1,3,4	2,3

Discipline Specific Course: Practical

Title: Mathematics Practical

Course code: RJDSCMATP361

Credits: 03

Practicals based on Algebra VI:

1. Cyclic Groups
2. Cyclic Subgroups
3. Cosets and Lagranges theorem
4. Group Homomorphism, Isomorphism and Automorphism
5. Normal subgroups and Quotient groups
6. Cayleys's Theorem and external direct product of groups

Practicals based on Basic Complex Analysis:

1. Limit and continuity and sequence of complex numbers
2. Derivatives of complex functions, analyticity, harmonic functions
3. Elementary functions and Linear fractional transformations
4. Complex integration, Cauchy integral formula and Cauchy integral theorem
5. Taylor's series, Laurent series and singularities
6. Calculation of residues and applications

Practicals based on Metric Spaces-II:

1. Compact sets in various metric spaces
2. Compact sets in $\mathbb{R}^n$
3. Connected sets
4. Path connectedness
5. Pointwise and uniform convergence of sequence of functions
6. Pointwise and uniform convergence of series of functions

SEMESTER	VI DISCIPLINE SPECIFIC COURSE
TITLE OF THE COURSE	MATHEMATICS PRACTICAL
COURSE CODE	RJDSCMATP361
CREDITS	03
DURATION	90 HOURS

LEARNING OBJECTIVES	
1	Learning concepts group and its types and isomorphism theorems of groups.
2	Learning concepts of analytic functions and properties
3	Learning compactness, connectedness, and sequences and series of functions

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO addressed	BLOOM'S LEVEL
CO1	Apply the knowledge of groups theory and isomorphism theorems groups	1,2,3	3
CO2	Understand calculus of analytic functions	1,2,3	3,4
CO3	Understand the concept of compactness and connectedness	1,2,3	3,4

Suggestive Scheme of Examination

Internal Assessments: There will be one Internal Assessment of 30 marks for each of the courses RJDSCMAT351, RJDSCMAT352, RJDSCMAT353 of Semester V and RJDSCMAT361, RJDSCMAT362, RJDSCMAT363 of Semester VI.

Internal Assessment Pattern: There will be one internal examinations for each courses RJDSCMAT351, RJDSCMAT352, RJDSCMAT353 of Semester V and RJDSCMAT361, RJDSCMAT362, RJDSCMAT363 of Semester VI. The internal assessment will be based on class tests / projects / assignments / book review / open book tests/ seminars.

Semester End Theory Examinations: There will be a Semester end theory examination of 45 marks for each of the courses RJDSCMAT351, RJDSCMAT352, RJDSCMAT353 of Semester V and RJDSCMAT361, RJDSCMAT362, RJDSCMAT363 of Semester VI.

1. Duration: The examinations shall be of 1.5 Hour duration.

2. Theory Question Paper Pattern:

Question Number	Unit	Particulars	Answer	Marks
1	1	A) Theory B) Theory	Attempt any one	7
		a) Problem b) Problem c) Problem d) Problem	Attempt any two	4 x 2=8
2	2	A) Theory B) Theory	Attempt any one	7
		a) Problem b) Problem c) Problem d) Problem	Attempt any two	4 x 2=8
3	3	A) Theory B) Theory	Attempt any one	7
		a) Problem b) Problem c) Problem d) Problem	Attempt any two	4 x 2=8

Semester End Practical Examinations:

At the end of the Semesters V and VI Practical examinations of 90-minute duration and of 75 marks shall be conducted for the courses RJDSCMAT351, RJDSCMAT352, RJDSCMAT353 of Semester V and RJDSCMAT361, RJDSCMAT362, RJDSCMAT363 of Semester VI.

Paper pattern: The question paper shall have three parts: I, II, and III.

Each part shall have two Sections.

Section A Objective Questions: Attempt any Four out of Six multiple choice questions.

(4 x 2 = 08 Marks)

Section B Descriptive Problems: Three questions based on each unit with internal choices.

(4x 3 = 12 Marks)

Practical Course	Part I	Part II	Part III	Marks	Duration
RJDSCMATP351	Questions from RJDSCMAT 351	Questions from RJDSCMAT 352	Questions from RJDSCMAT 353	60 (20+20+20)	90 minutes
RJDSCMATP361	Questions from RJDSCMAT 361	Questions from RJDSCMAT 362	Questions from RJDSCMAT 363	60 (20+20+20)	90 minutes

Marks for Journals:

For each courses RJDSCMAT351, RJDSCMAT352, RJDSCMAT353 of Semester V and RJDSCMAT361, RJDSCMAT362, RJDSCMAT363 of Semester VI.

Journals: 05 marks.

Each Practical of every course of Semester V and VI shall contain 10 (ten) problems out of which minimum 05 (five) have to be written in the journal. A student must have a certified journal before appearing for the practical examination.