



# UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A' GRADE UNIVERSITY)  
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section

Email: [academicsectionju14@gmail.com](mailto:academicsectionju14@gmail.com)

## NOTIFICATION

(23/May/Adp./ 36)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the revised Syllabi and Courses of Study of subject of **Mathematics** for Master Degree Programme of Semesters **Ist** and **IInd** under the **Choice Based Credit System (as given in the annexure)** for the examinations to be held in the years as per the details given below:

Subject	Semester	for the examination to be held in the years
Mathematics	Semester-I	December 2023, 2024 and 2025
	Semester-II	May 2024, 2025 and 2026

The Syllabi of the courses is available on the University website:  
[www.jammuuniversity.ac.in](http://www.jammuuniversity.ac.in)

Sd/-  
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/23/ 3397-3407  
Dated: 25-5-2023.

Copy for information and necessary action to:

1. Dean, Faculty of Mathematical Science
2. Convener, Board of Studies in **Mathematics**
3. Sr. P.A. to the Controller of Examinations
4. All members of the Board of Studies
5. Confidential Assistant to the Controller of Examinations
6. I/C Director, Computer Centre, University of Jammu
7. Deputy Registrar/Asst. Registrar (Conf. /Exams. UG/Eval Non-Prof)
- ✓ 8. Incharge, University Website for Uploading of the notification.

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24/5  
Deputy Registrar (Academic)

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24/5/23

Revised Syllabi and Course of Study of Two  
Years Master Degree Programme in Mathematics  
(CBCS)  
University of Jammu.

The Master Degree Programme in Mathematics of University of Jammu is a two years CBCS programme consisting of four semesters and carries 88 credits with each Course of 4 Credits and the Dissertation in Semester IV shall carry 8 Credits. All courses in Semesters I and II are compulsory, In Semester III, first three courses are compulsory and students can choose any two courses out of rest of the given courses whereas in Semester IV, students can choose any three courses out of the given list of courses and there shall be a Dissertation of 8 credits. Students are required to earn 4 more credits each in Semester III and IV from a MOOC course from SWAYAM platform in Semester III and from an open course in Semester IV (given by different departments at the Campus as laid down in the CBCS guidelines of the University).

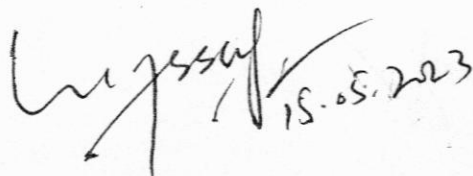
Titles of the Courses in each Semester

**Semester I**

1. PSMATC101     Abstract Algebra
2. PSMATC102     Real Analysis
3. PSMATC103     First Course in Topology
4. PSMATC104     Differential and Integral Equations
5. PSMATC105     Fundamentals of Computers

**Semester II**

1. PSMATC201     Rings and Modules
2. PSMATC202     Measure Theory
3. PSMATC203     Second Course in Topology
4. PSMATC204     Complex Analysis

  
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5. PSMATC205 Differential Geometry

**Semester III**

1. PSMATC301 Advance Complex Analysis

2. PSMATC302 Functional Analysis

3. PSMATC303 Linear Algebra

4. PSMATC304 Advance Measure Theory

5. PSMATC305 Complex Dynamics

6. PSMATC306 Partial Differential Equations

7. PSMATC307 Number Theory

8. PSMATC308 Multivariable Calculus

9. PSMATC309 Linear Programming and Optimization

10. PSMATC310 Numerical Methods

11. PSMATC311 Graph Theory

**Semester IV**

1. PSMATC401 Analytic Function Spaces

2. PSMATC402 Advance Functional Analysis

3. PSMATC403 Operator Theory

4. PSMATC404 Normal Families in Complex Analysis

5. PSMATC405 Value Distribution of Meromorphic Functions

6. PSMATC406 Geometric Function Theory

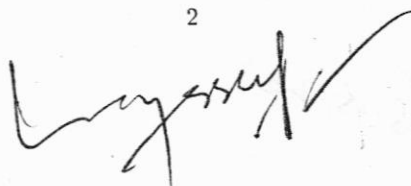
7. PSMATC407 Complex Analysis in Several Variables

8. PSMATC408 Algebraic Topology

9. PSMATC409 Harmonic Analysis

10. PSMATC410 Masters Dissertation

11. PSMATO411 Numerical Methods and Graph Theory  
(This is an open course for students of other departments)



Revised Syllabi and Course of Study of Two Years Master Degree  
Programme in Mathematics (CBCS)  
University of Jammu.

SEMESTER I

(Examination to be held in December 2023, 2024, 2025)

Course Code: PSMATC101  
Credits: 04

Course Title: Abstract Algebra  
Total Number of Lectures: 60

Maximum Marks: 100, Minor I: 20 Marks, Minor II: 20 Marks,  
Major: 60 Marks

**Objectives:** The aim of this course is to continue an UG Course on Algebra to next level.

**Prerequisite of this course:** UMJMAT402

**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

Unit-I

Conjugacy classes, class equation, centre of a group, Cauchy's theorem,  $p$ -groups, Sylow's Theorem I, II and III. Internal direct sums and direct products of finite groups. Finite Abelian groups as direct sums of Sylow subgroups.

Unit-II

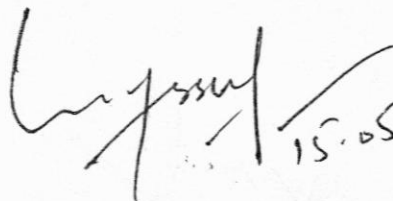
Normal and subnormal series, Solvable groups, Solvability of subgroups, factor groups and of finite  $p$ -groups, Commutator subgroups and solvability. Simple groups. Composition series. Jordan-Holders theorem for finite groups. Simplicity and non-solvability of  $A_n$ ,  $n \geq 5$ .

Unit-III

Modules, submodules, sum of submodules, finitely generated modules, cyclic modules, finite direct sum and direct product. Quotient Modules, homomorphisms, Isomorphism theorems. Submodules of Quotient Modules, Ring as a modules over itself and its submodules, Algebra of ideals of a ring, maximal and prime ideals, ideals of quotient Ring.

Unit-IV

Unit, prime and irreducible elements of a ring. Factorization domain and the ascending chain condition on principal ideals.  $R[x]$  the polynomial rings as a factorization domain when  $R$  is a factorization domain. The ring  $\mathbb{Z}[x]$  as a factorization domain. Euclidean domain and principal ideal domain as factorization domains. Unique factorization domain and the irreducible and prime elements of U.F.D., Polynomial rings over a U.F.D. Eisenstein's irreducibility criterion and Gauss theorem.

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**Text Books:**

1. I. N. Herstein. Topics in Algebra, Wiley, 2nd edition, 1975. (Unit-I & II)
2. D. S. Dummit and R. M. Foote, Abstract Algebra, Wiley, 3rd edition, 2011.

**Reference Books:**

1. J. A. Gallian, Contemporary Abstract Algebra, 9th Edition, Brooks/Cole Cengage Learning, 2017.
2. N. Jacobson, Basic Algebra I, Dover Publications Inc, 2nd edition, 2009.
3. T. A. Hungerford, Algebra, Graduate Texts in Mathematics, Springer-Verlag, 1980.
4. C. Musili, Introduction to Rings and Modules, Narosa Publishing House, 1984.
5. N.S.Gopalakrishnan, University Algebra, second Edition, Wiley Eastern Ltd., New Delhi 1994.

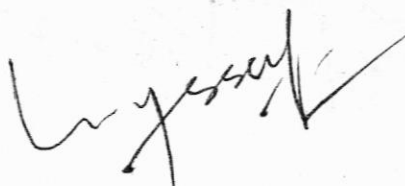
**Scheme of Examination:**

There shall be three tests and the students shall be continuously evaluated on the basis of their performance as follows:

Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
Minor test-I (after 30 days)	up to 25 %	1 hour 30 min.	20
Minor test-II (after 60 days)	up to 50 %	1 hour 30 min.	20
Major test (after 90 days)	up to 100 %	3 hour	60

**Note for paper setting of Major Test:**

- i) There shall be two sections in the question paper, namely, Section A and Section B.
  - a) Section A shall have one question equally distributed over Unit-I and Unit-II.
  - b) Section B shall have four questions equally distributed over Unit-III and Unit-IV.
- ii) Each question shall be of the same weightage of 12 marks.
- iii) There shall be 100 % internal choice.



Revised Syllabi and Course of Study of Two Years Master Degree  
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SEMESTER I

(Examination to be held in December 2023 2024, 2025)

Course Code: PSMATC102 Course Title: Real Analysis Credits: 04

Total Number of Lectures: 60

Maximum Marks: 100, Minor I: 20 Marks, Minor II: 20 Marks,  
Major: 60 Marks

**Objectives:** The conventional portion of limits, continuity and differentiability on  $\mathbb{R}$  have been done at undergraduate level. The purpose of this Course is to introduce some of the remaining portion of Real Analysis Viz. Topology of  $\mathbb{R}^n$ , the uniform continuity, uniform convergence of sequences and series of functions, Riemann-Stieltjes integrals and functions of several variables.

**Prerequisite of this course:** Undergraduate Calculus Courses.

**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

Unit-I

Elements of Point Set Topology: Euclidean Space  $\mathbb{R}^n$ , Open ball and Open sets in  $\mathbb{R}^n$ , Closed sets, adherent sets, Bolzano-weistrass theorem, Cantor intersection theorem, Lindeloff covering theorem, Hein-Borel theorem, compactness in , Metric spaces, open sets and closed sets in metric spaces, compact subsets of metric spaces, Boundary of a set in metric spaces.

Unit-II

Riemann-Stieltjes Integral: Definition of Riemann-Stieltjes integral, linear properties of R-S integrals, integration by parts, change of variable, reduction to Riemann-Stieltjes integral to finite sum, Euler's summation formula, upper and lower R-S integrals, Riemann's condition, comparison theorems. First and second mean value theorems for R-S integrals. Function of bounded variation, total variation, additive property of total variation. Total variation on  $[a, x]$  expressed as the difference of increasing functions. Rectifiable path and arc length. First and second fundamental theorems of integral calculus.

Unit-III

Pointwise and uniform convergence, uniform convergence and continuity, Cauchy condition for uniform convergence, uniform convergence of infinite series. Weistrass M-test, uniform convergence and R-S integration, uniform convergence and differentiation. Power series, multiplication of power series, the substitution theorem. Reciprocal of a power series, Taylor's series generated by a function. Bernstein's theorem. Abel's limit theorem, Tauber's theorem.

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#### Unit-IV

Functions of Several Variables: The Directional derivative, total derivative, matrix of a linear function, Jacobian matrix and the chain rule. The Mean value theorem for differentiable functions. a sufficient condition for differentiability, a sufficient condition for equality of mixed partial derivatives, Taylor's formula for function from  $\mathbb{R}^n$  to  $\mathbb{R}^n$ . Functions with non-zero Jacobian determinant, the inverse function theorem. the implicit function theorem (only statements).

#### Text Books:

Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.

#### Reference Books:

1. W. Rudin : Principles of Mathematical Analysis, McGraw Hill International Edition (Third edition), 1976.
2. Steven G. Krantz, Real Analysis and Foundations, CRC Press Inc., 1991.
3. Robert T. Seeley. Calculus of Several Variables. Scott. Foresman and Company, 1970.
4. S.C. Malik and Savita Arora, Mathematical Analysis, Wiley Easter, New Delhi 1984.

#### Scheme of Examination:

There shall be three tests and the students shall be continuously evaluated on the basis of their performance as follows:

Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
Minor test-I (after 30 days)	up to 25 %	1 hour 30 min.	20
Minor test-II (after 60 days)	up to 50 %	1 hour 30 min.	20
Major test (after 90 days)	up to 100 %	3 hour	60

#### Note for paper setting of Major Test:

- i) There shall be two sections in the question paper, namely, Section A and Section B.
  - a) Section A shall have one question equally distributed over Unit-I and Unit-II.
  - b) Section B shall have four questions equally distributed over Unit-III and Unit-IV.
- ii) Each question shall be of the same weightage of 12 marks.
- iii) There shall be 100 % internal choice.

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**Revised Syllabi and Course of Study of Two Years Master Degree  
Programme in Mathematics (CBCS)  
University of Jammu.**

**SEMESTER I**

(Examination to be held in December 2023, 2024, 2025)

**Course Code: PSMATC103 Course Title: First Course in Topology**  
**Credits: 04 Total Number of Lectures: 60**

**Maximum Marks: 100, Minor I: 20 Marks, Minor II: 20 Marks,**  
**Major: 60 Marks**

**Objectives:** The syllabus aims to familiarize students with the essential concepts and techniques of set theory and topology. The first part of the syllabus includes topics such as Axioms of Choice, cardinality, and the continuum hypothesis. The second part focuses on topological spaces, continuous functions, and their properties like connectedness, compactness, and limit points. The goal is to provide students with a solid understanding of mathematical reasoning and problem-solving, allowing them to apply these concepts in various mathematical contexts. The problems and exercises based on these concepts are intended to develop their analytical and critical thinking skills.

**Prerequisite of this course:** Undergraduate course on set theory and real analysis.

**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

**Unit-I**

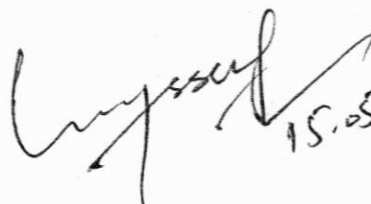
Cartesian product of a family of sets, Axioms of Choice and some of its equivalent forms: Hausdorff Maximality Principle, Zorn's Lemma, the well-ordering principle. Applications of Zorn's Lemma, the principle of transfinite induction. The concept of the cardinal numbers, ordering of cardinal numbers, the Schröder-Bernstein Theorem, cardinal number of power set, Cantor's Theorem, the continuum hypothesis and its generalization. Problems and exercises based on these concepts.

**Unit-II**

Topological Spaces, basis and subbasis for a topology, order topology, product topology, Subspace topology, closed sets and limit points, closure and interior sets, Hausdorff space. Problems and exercises based on these concepts.

**Unit-III**

Continuous functions, homeomorphisms, the pasting lemma, product topology, box topology and uniform topology and their relationships. Metric topology, the sequence lemma, Uniform limit theorem, quotient topology. Problems and exercises based on these concepts.

  
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#### Unit-IV

Connectedness, path connectedness, components and local connectedness, compact spaces, compact subspaces of the real line, uniform continuity theorem, finite intersection property, limit point compactness, sequential compactness. Concept of Nets. Problems and exercises based on these concepts.

##### Text Books:

1. T Lin and You-Feng Linc, Set Theory, Houghton Mifflin Company Boston, 1974 (for Unit-I).
2. J. R. Munkres, Topology, Pearson Education India, 2013 (for Unit-II, III & IV).

##### Reference Books:

1. H. B. Ederton, Elements of Set Theory, Academic Press, 1977.
2. P. R. Halmos, Naive Set Theory, East-West Press, 1960.
3. M. H. A. Newman, Elements of the Topology of Plane Sets of Points, 2nd edn. Cambridge University Press, 1951.
4. S. Willard, General Topology, Addison Wesley, 1970.
5. G. F. Simmons. Introduction to Topology and Modern Analysis, McGraw-Hill Education, 1963.
6. J. Dugundji, Topology, Allyn and Bacon, 1966.
7. J. L. Kelley, General Topology, Springer Science & Business Media, 1975.

##### Scheme of Examination:

There shall be three tests and the students shall be continuously evaluated on the basis of their performance as follows:

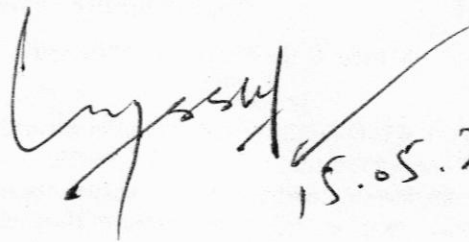
Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
Minor test-I (after 30 days)	up to 25 %	1 hour 30 min.	20
Minor test-II (after 60 days)	up to 50 %	1 hour 30 min.	20
Major test (after 90 days)	up to 100 %	3 hour	60

##### Note for paper setting of Major Test:

- i) There shall be two sections in the question paper, namely, Section A and Section B.

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- a) Section A shall have one question equally distributed over Unit-I and Unit-II.
  - b) Section B shall have four questions equally distributed over Unit-III and Unit-IV.
- ii) Each question shall be of the same weightage of 12 marks.
  - iii) There shall be 100 % internal choice.

  
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Revised Syllabi and Course of Study of Two Years Master Degree  
Programme in Mathematics (CBCS)  
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SEMESTER I

(Examination to be held in December 2023, 2024, 2025)

Course Code: PSMATC104 Course Title: Differential and Integral  
Equations Credits: 04 Total Number of Lectures: 60

Maximum Marks: 100, Minor I: 20 Marks, Minor II: 20 Marks,  
Major: 60 Marks

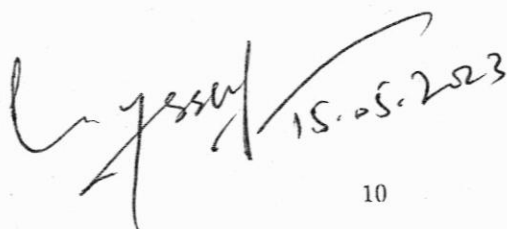
**Objectives:** The subject of Differential Equations is the natural application of elementary calculus and most important part of Mathematics for understanding the physical sciences, engineering and technology, economics etc. Also, in the deeper questions it generates, it is the source of most of the ideas and theories which constitute higher analysis. It is indispensable for understanding the nature mathematically. So the objective of this course is to make the students understand the physical world mathematically besides preparing to do analysis at higher levels.

**Prerequisite of this course:** Undergraduate course on Calculus.

**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

Unit-I

Existence and uniqueness theorem for first order differential equations, Picard's method of successive approximations. Linear differential equation of order  $n$ , definition and basic existence theorem, basic theorem on linear homogeneous differential equation, idea of linear independence and linear dependence, Wronskian, method of reduction of order, method of variation of parameters, the Cauchy Euler equation. Examples and exercises on these topics with applications in electric circuits.

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## Unit-II

Power series solutions about ordinary points, definitions and existence theorem, solutions of Legendre equation, Legendre polynomials, generating function, Rodrigues formula, and orthogonality property of Legendre's polynomials. Power series solutions about singular points- the method of Frobenius, definition, existence theorem, the method of Frobenius, solutions of Bessel's equations, Bessel's functions and their properties. Gauss hypergeometric differential equations and functions defined by them with some important properties- Chebyshev polynomials and minimax property, Riemann's equations- the generalized Gauss hypergeometric equations. Examples and exercises based on these topics.

## Unit-III

Laplace transform: Definition, Existence and Basic properties of Laplace transform, the Inverse Laplace transform and the convolution, applications of Laplace transform to linear differential equations with constant coefficients, Sturm-Liouville boundary value problems: Definitions and examples, characteristic values and characteristic functions, and orthogonality of characteristic functions. Green's function: Concept of Green's function, properties of Green's function. Construction of Green's function for various differential operators, and idea of Dirac- delta function. Examples and exercises based on these topics.

## Unit-IV

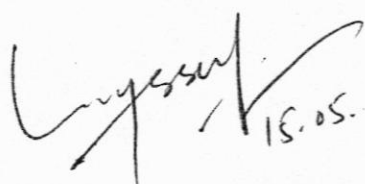
Linear Integral Equations: Introduction, classifications- Fredholm and Volterra equations, conversion of differential equations into integral equations- IVP and BVP, Fredholm equations with degenerate Kernels- equations of first and second kinds, Fredholm equations- method of resolvent Kernels, Volterra equations- Resolvent Kernels. Examples and exercises based on these topics.

### Text Books:

1. S.L. Ross: Differential Equations, 3rd Edition, John Wiley and Sons (Asia) Pvt. Ltd. 2004 (for unit I, II, and III).
2. B.P. Prasher: Differential and Integral Equations, CBS Publishers and Distributors, Delhi- 1989 (for Units III and IV).

### Reference Books:

1. G.F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw- Hill 2003.
2. W. E. Boyce, and R.C. DiPrima, Elementary Differential Equations and Boundary value Problems, John Wiley and Sons, 1977.
3. E. A. Coddington, An Introduction to Ordinary Differential Equation, Prentice Hall of India Pvt. Ltd., New Delhi 2005.

  
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4. R. P. Kanwal, Linear Integral Equations- Theory and Techniques, Academic Press, New York, 1971.
5. F.G. Roach, Green's Function, Von Nostrand, 1970.

**Scheme of Examination:**

There shall be three tests and the students shall be continuously evaluated on the basis of their performance as follows:

Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
Minor test-I (after 30 days)	up to 25 %	1 hour 30 min.	20
Minor test-II (after 60 days)	up to 50 %	1 hour 30 min.	20
Major test (after 90 days)	up to 100 %	3 hour	60

**Note for paper setting of Major Test:**

- i) There shall be two sections in the question paper, namely, Section A and Section B.
  - a) Section A shall have one question equally distributed over Unit-I and Unit-II.
  - b) Section B shall have four questions equally distributed over Unit-III and Unit-IV.
- ii) Each question shall be of the same weightage of 12 marks.
- iii) There shall be 100 % internal choice.

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Revised Syllabi and Course of Study of Two Years Master Degree  
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University of Jammu.

SEMESTER I

(Examination to be held in December 2023, 2024, 2025)

Course Code: PSMATC105

Course Title: Computer Applications in Mathematics

Credits: 04

Total Number of Lectures: 60

Maximum Marks: 100, Minor I(Laboratory Work): 20 Marks

Minor II(Laboratory Work): 20 Marks

Major: 60 Marks.

**Objectives:** The course aims to develop:

1. basic understanding of the problem solving using Computer and developing skills to prepare technical mathematical write-ups.
2. familiarity with the concepts and terminologies that is essential to mathematical problem solving.
3. the minimal and invasive knowledge and skills developed through this course will enable to understand the Computer Science subjects in a better way and explore further developments in the area.

**Prerequisite of this course:** Basics of mathematics and computers.

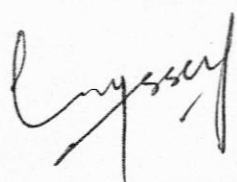
**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

Unit-I

Mathematical writing using LaTeX Introduction to LaTeX, Basic Syntax, Latex Compilation, DVI file, Formatting Text- Fonts, Shapes and Styles, Line spacing, Two-column landscape document, Table of Contents, Page Breaks. Customizing header and footer, Footnotes, Bulleted and Numbered Lists, Tables, Combining rows and columns, Merging cells with multirow package, Label and reference of picture, Generating an index page, Creating bibliography-citing text and listing the references.

Unit-II

C-Language Fundamentals, Programming Language and its Types, Language Compiler and Interpreter, Characteristics of C, C Program Structure, C Pre-processor Directives, Statements and Functions. Executing C-program, Data Types, Input Output functions, Operators and Expressions, Control statements, Repetitive statements, Programming Exercises.

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### Unit-III

Data Representation and Processing Fundamentals Arrays, Strings, Two Dimensional Arrays, Representing matrices and performing matrix operations, Structures, User-defined Functions, Concepts of File Management, Working with text and Binary Files, Programming Exercises base on Arrays: like, searching an item, finding minimum/maximum item finding average and standard deviation etc.

### Unit-IV

Programming in Mathematica Expressions, Special Input Forms, Lists and Strings, Generating Lists, Manipulating Lists, Character Strings, Procedural Programming, Functions, Conditional Execution, Iteration, Parameter-Passing Semantics, Matrices and operations, Scalars and Vectors, Solving linear system of equations, Eigen Values and Eigen Vectors, Tensors.

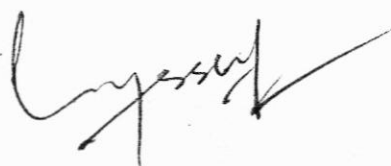
#### Reference Books:

1. Stefan Kottwitz, Latex: Beginner's guide (1st edition), Packt publishing, Indian edition, 2011.
2. Lammport Leslie, LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Pearson Education, Indian Reprint, 1994.
3. SwapnaKumar, Latex -A beginner guide to professional documentation (1st edition), Trinity Press, 2019.
4. E. Balagurusamy, Programming with ANSI-C, Sixth Edition, Tata McGraw Hill, 2012.
5. H. M. Deitel and P. J. Deitel, How to program, 7th edition, Pearson Education, 2010.
6. Stephen Wolfram, The Mathematica (5th Edition), Wolfram Media, 2003.
7. Sal Mangano, Mathematica Cookbook (1st edition), O'relley Publications, 2010.

#### Scheme of Examination:

There shall be three tests and the students shall be continuously evaluated on the basis of their performance as follows:

Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
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Minor test-II (after 60 days)	up to 50 %	1 hour 30 min.	20
Major test (after 90 days)	up to 100 %	3 hour	60



**Note for paper setting of Major Test:**

- i) There shall be two sections in the question paper, namely, Section A and Section B.
  - a) Section A shall have one question equally distributed over Unit-I and Unit-II.
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SEMESTER II

(Examination to be held in May 2024, 2025, 2026)

Course Code: PSMATC201      Course Title: Rings and Modules  
Credits: 04      Total Number of Lectures: 60

Maximum Marks: 100,    Minor I: 20 Marks,    Minor II: 20 Marks,  
Major: 60 Marks

**Objectives:** The aim of this course is to extend the study of algebraic structures beyond group structures. In this course the algebraic structures like rings and modules are considered.

**Prerequisite of this course:** PSMATC101

**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

Unit-I

Annihilators of Modules, change of Rings, faithful Modules, simple Modules. Primitive ideal. Homomorphic images of prime, primitive and maximal ideals, prime, primitive and simple Rings. Existence of maximal ideal and minimal prime ideals of a ring. Prime radical and semi-prime ideals. Jacobson radical and quasi-regular elements. Case of commutative rings. Matrix rings and their ideals.

Unit-II

Chain condition on Modules. Noetherian and Artinian Modules. Noetherian and Artinian rings. Maximum and minimum conditions. Case of direct products and matrix rings. Hilbert basis theorem.

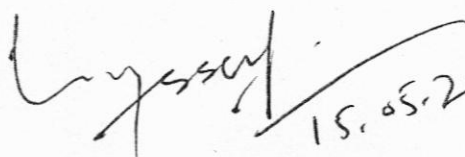
Unit-III

Prime radical in the Noetherian case. Nakayama lemma and Jacobson radical in the Artinian case. Opposite ring and Schur's lemma. Chevalley Jacobson density theorem. Structure of simple Artinian rings, Prime ideals of an Artinian ring. Neotherianness of Artinian rings.

Unit-IV

Free modules. modules over a P.I.D., submodules of a free module over a P.I.D., Torsion and Torsion free modules, Structure theorem for finitely generated modules over a P.I.D., The elementary divisor theorem, Applications to finite abelian groups.

**Text Books:**

  
15.05.2023

1. N.H. McCoy, The Theory of Rings, New York, Macmillan 1964. (Unit-I)
2. C. Musili, Introduction to Rings and Modules, Narosa Pub. House, New Delhi, 1994. (Unit-II,III & IV)

**Reference Books:**

1. D. S. Dummit and R. M. Foote, Abstract Algebra, Wiley, 3rd edition, 2011.
2. N. Jacobson, Basic Algebra I & II, Dover Publications Inc, 2nd edition, 2009.
3. T. A. Hungerford, Algebra, Graduate Texts in Mathematics, Springer-Verlag, 1980.
4. Atiyah M.F. and MacDonald I. G., Introduction to commutative algebra, CRC Press, 2018

**Scheme of Examination:**

There shall be three tests and the students shall be continuously evaluated on the basis of their performance as follows:

Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
Minor test-I (after 30 days)	up to 25 %	1 hour 30 min.	20
Minor test-II (after 60 days)	up to 50 %	1 hour 30 min.	20
Major test (after 90 days)	up to 100 %	3 hour	60

**Note for paper setting of Major Test:**

- i) There shall be two sections in the question paper, namely, Section A and Section B.
  - a) Section A shall have one question equally distributed over Unit-I and Unit-II.
  - b) Section B shall have four questions equally distributed over Unit-III and Unit-IV.
- ii) Each question shall be of the same weightage of 12 marks.
- iii) There shall be 100 % internal choice.

*Handwritten signature and date: 15.5.2023*

Revised Syllabi and Course of Study of Two Years Master Degree  
Programme in Mathematics (CBCS)  
University of Jammu.

SEMESTER II

(Examination to be held in May 2024, 2025, 2026)

Course Code: PSMATC202

Course Title: Measure Theory

Credits: 04

Total Number of Lectures: 60

Maximum Marks: 100, Minor I: 20 Marks, Minor II: 20 Marks,  
Major: 60 Marks

**Objectives:** The main purpose of this course is to study general theory of measure integration. The theory of measures has its origin in the idea of length, area and volume in Euclidean spaces. It has a lot of application in functional theory and several branches of Physics.

**Prerequisite of this course:** PSMATC102

**Structure of the Course:** This course is divided into four units of 15 class lectures each, wherein one lecture is of one hour duration.

Unit-I

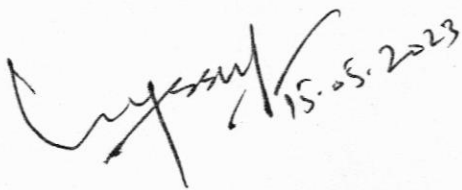
$\sigma$ -algebra of sets, limits of sequences of sets. Generation of algebras, Borel  $\sigma$ -algebra,  $G_\delta$  and  $F_\sigma$  sets. Measure on  $\sigma$ -algebra, Measures of sequences of sets, Measurable spaces and measure space. Outer measures, regular outer measure, metric outer measure, construction of outer measure. Examples and exercises on these topics.

Unit-II

Lebesgue outer measure on  $\mathbb{R}$ , properties of Lebesgue measure spaces, translation invariances of Lebesgue measure. Existence of non-Lebesgue measurable sets. Regularity of Lebesgue outer measure. Cantor ternary set and cantor function. Relation between Lebesgue and Borel measurability, completion of measure space. Completion of Borel measure space to the Lebesgue measure space. Examples and exercises on these topics.

Unit-III

Measurable functions, Operation with measurable function, equality a.e., Sequence of measurable functions, continuity and Borel Lebesgue measurability of functions on  $\mathbb{R}$ , integration of simple functions, Lebesgue integral of non-negative and measurable functions. Properties of Lebesgue integrals. Examples and exercises on these topics.

  
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#### Unit-IV

Convergence a.e., Almost uniform convergence, Egoroff's theorem, convergence in measure, convergence in mean, Cauchy sequence in measure, relation among various convergence types. Fatou's lemma, Lebesgue monotone convergence theorem. Lebesgue dominated theorem. Examples and exercises based on these concepts.

**Text Books:** J. Yeh : Lectures on Real Analysis, World Scientific, 2000.

**Reference Books:**

1. M.E. Munroe : An Integration 2nd ed. Addison Wesley, 1971.
2. G.D. Barra : Measure Theory and Integration, Wiley Eastern 1987.
3. H.L. Royden : Real Analysis, 3rd edition, Macmillan, New York 1988.

**Scheme of Examination:**

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Theory	Syllabus to be covered in the examination	Time allotted for the examination	% weight age marks
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- iii) There shall be 100 % internal choice.

*Signature*  
15.05.2023