University of Jammu

Syllabus of Mathematics at FYUGP under CBCS as per NEP-2020.

SEMESTER V
(Examination to be held in December 2024, 2025, 2026)
Major Course

Course Code: UMJMAT-501
Course Title: Abstract Algebra-II
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Centre of group, centralizer of a group, $o(HK) = \frac{o(H)o(K)}{o(H \cap K)}$, for finite subgroups H and K of a group G, Euler $\phi-$ function, number of generators of a cyclic group of order n is $\phi(n)$, structure theorem for a cyclic group, Direct product of subgroups of a group, Examples and exercises based on these concepts.

Unit-II

Automorphism of a group, inner automorphism of a group, the number of automorphisms of a group of order n is $\phi(n)$, Group of all automorphisms of a group G, $A(G)$, the set of all inner automorphisms of a group G, $I(G)$ is subgroup of $A(G)$. Examples and exercises based on these concepts.

Unit-III

Permutation group S_n, A_n the subroup of S_n, $o(A_n) = \frac{n!}{2}$, transpositions, cycle of order r, signature of permutation, Caley's theorem, Converse of Lagrange's theorem. Examples and exercises based on these concepts.

Unit-IV

Definition of Ring, division ring, subring, ideal, skew field, field, integral domain. Examples based on number system, matrices, polynomials, Gaussian integers. Ring homomorphism, Kernel and Image of ring homomorphism, isomorphism, First fundamental theorem of ring homomorphism. Idea of prime and maximal ideals of a ring. Examples and exercises based on these concepts.

Text Books:

1. *Topics in Algebra*, I. N. Herstein, John Wiley and Sons.

Reference Books:

1. *Modern Algebra*, Surjeet Singh and Qazi Zameeruddin, Vikas Publishing House Pvt. Ltd.
2. *Algebra*, Michael Artin, PHI Pvt. Ltd.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER V
(Examination to be held in December 2024, 2025, 2026)
Major Course

Course Code: UMJMAT-502
Course Title: Linear Algebra-I
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Linear equations: solutions of homogeneous and non-homogeneous linear equations, Determinant: definition and its properties viz $D(AB) = D(A)D(B)$, Cramer's Rule. Matrices: symmetric, skew-symmetric, Hermitian, skew-Hermitian, unitary and orthogonal, Rank of a matrix, Examples and exercises based on these concepts.

Unit-II

Similar matrices, characteristic polynomial, characteristic minimal polynomial, characteristic roots, charcteristic vectors, Diagonalization of a matrix, Caley-Hamilton theorem, Examples and exercises based on these concepts.

Unit-III

Vector space, subspace of a vector space, quotient space, linear combination of vectors, linear span, linearly independent and linearly dependent vectors, examples and exercises based on these concepts.

Unit-IV

Basis and dimension of a vector space, Existence of a basis for finite dimensional vector space, Extension theorem, $\dim(V+W) = \dim V + \dim W - \dim(V \cap W)$ for V, W subspaces of a vector space U, $\dim(V/W) = \dim V - \dim W /$ Examples and exercises based on these concepts.

Text Books:

1. *University Algebra*, N. S. Gopalakrishnan, PHI.

Reference Books:

1. *Linear Algebra*, Kennneth Hoffman and Ray Kunz, PHI.
2. *Modern Algebra*, Surjeet Singh and Qazi Zameeruddin, Vikas Publishing House Pvt. Ltd.

3. *Algebra*, Michael Artin, PHI Pvt. Ltd.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

University of Jammu
Syllabus of Mathematics at FYUGP under CBCS as per NEP-2020.

SEMESTER V
(Examination to be held in December 2024, 2025, 2026)
Minor Course

Course Code: UMIMAT-503
Course Title: Probability Theory
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, **Theory:** 75, **Tutorial:** 25

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

Sample Space, Probability Axioms, Real Random Variable, Cumulative Distribution Function, Probability Mass/ Density Function, Mathematical Expectations, Moments About Origin and Moments about Mean, Moment Generating Function. Examples and exercises based on these concepts.

Unit-II

Bernoulli, Binomial and Poisson Distribution. Mean, Mode, Variance, Moments and Moment Generating Functions of these Distributions, Recurrence relations of Binomial and Poisson Distributions. Examples and exercises based on these concepts.

Unit-III

Normal Distribution, Mean, Mode, Variance, Median and Moments about Mean of Normal Distribution, 95% Confidence Interval for Mean of Population, Properties of Normal Curve. Examples and exercises based on these concepts.

Unit-IV

χ^2- Distribution, Moment Generating Function of χ^2- Distribution, Mode and Skewness of χ^2- Distribution. Uniform Distribution, Its Mean, Mode, Variance and Moments about Mean, Properties of Uniform Distribution. Examples and exercises based on these concepts.

Text Books:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig,*Introduction to Mathematical Statistics,* Pearson Education, Asia, 2007.

Reference Books:

1. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application,* 7th Ed., Pearson Education, Asia, 2006.

2. S. Lipschutz and J. Schiller, *Introduction to Probability and Statistics,* McGraw Hill Education, 2017.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER V
(Examination to be held in December 2024, 2025, 2026)
Minor Course

Course Code: UMJMAT-504
Course Title: Set Theory
Credits: 02
Total Number of Lectures: Theory: 30
Maximum Marks: 50

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

Sets, Subsets and operations on them, Indexed Families of Sets, Cartesian Product of Two Sets, Relations, Partitions and Equivalence Relations, Functions: Injective, Surjective and Bijective functions, Composition of Functions. Examples and exercises based on these concepts.

Unit-II

Finite and Infinite Sets, Equipotent Sets, Denumerable and Non-denumerable Sets and their properties. Examples and exercises based on these concepts.

Unit-III

The Concept of cardinal Numbers, Ordering of the Cardinal Numbers-The Schroder-Bernstein Theorem, Cardinal Number of Power Set- Cantor Theorem, Addition o Cardinal Numbers. Examples and exercises based on these concepts.

Text Books:

1. P. R. Halmos, *Naive Set Theory,* Springer, 2019.

Reference Books:

1. Lin, Shwu-Yeng T, *Set Theory with Applications,* Mancorp Publications, New Edition, 1985.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER V
(Examination to be held in December 2024, 2025, 2026)
Minor Course

Course Code:USEMAT-506
Course Title: Summer Internship
Credits: 02
Maximum Marks: 50

Objectives: It shall be a short-term internship of 15 days duration in 5th semester for a job/professional training in a suitable organization or hands on training or activity-based course at college level in order to gain work experience.

All students will undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs / research institutions during the summer term. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Community engagement and service: The curricular component of "community engagement and service" seeks to expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity.

Field-based learning/minor project: The filed-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community., and innovative practices required to generate solutions to the identified problems. This may be a summer term project.

SCHEME OF EXAMINATION

The internship shall be under a college teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out signed by internship supervisor and college principal. The internship will be evaluated internally by a Board of Examiners set up by the principal of the college.

Note: The minimum passing criteria for the summer internship is 40%.

SEMESTER VI
(Examination to be held in May 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-601
Course Title: Linear Algebra-II
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Linear Transformation (vector space homomorphism), isomorphism of two vector spaces, First fundamental theorem of isomorphism, kernel and image of a linear Transformation, $L(U, V)$ the set of all linear transformations from a vector space U to a vector space V is a vecor space, Examples and exercises based on these concepts.

Unit-II

$\dim L(U, V) = \dim(U) \dim(V)$, Dual space of a finite dimensional vector space, dual basis, $\dim(V^*) = \dim(V)$ for a finite dimensional vector space V, Double dual of a vector space, isomorphism between vector spaces and their double dual. Examples and exercises based on these concepts.

Unit-III

Algebra of linear transformations on a vector space, Rank-Nullity theorem, inverse of linear transformation on finite dimensional vector space, examples and exercises based on these concepts.

Unit-IV

Matrix representation of a linear transformation, one-one correspondence between linear transformations on finite dimensional vector spaces and matrices, Matrix representation of linear transformation with change of a basis, examples and exercises based on these concepts.

Text Books:

1. *University Algebra*, N. S. Gopalakrishnan, PHI.

Reference Books:

1. *Linear Algebra*, Kennneth Hoffman and Ray Kunz, PHI.

2. *Modern Algebra*, Surjeet Singh and Qazi Zameeruddin, Vikas Publishing House Pvt. Ltd.

3. *Algebra*, Michael Artin, PHI Pvt. Ltd.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.
(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VI
(Examination to be held in May 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-602
Course Title: Numerical Methods
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Finite differences, the operators Δ, ∇, E, D, and relations between them, separation of symbols. Interpolation: Linear and quadratic interpolation. Newton's forward and backward differences interpolation formula. Problems and Exercises based on these topics to be done as tutorials.

Unit-II

Central differences, Gauss's forward and backward interpolation formulas, Sterling's formula, Bessel's formula, Lagrange's interpolation formula (inverse interpolation). Problems and Exercises based on these topics to be done as tutorials.

Unit-III

Numerical Differentiation: Forward, backward and central difference formulas for numerical differentiation, maxima and minima of a tabulated function. Problems and Exercises based on these topics to be done as tutorials.

Unit-IV

Numerical Integration: Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's $\frac{1}{3}$ and $\frac{3}{8}$ rule, Boole's rule, Maclaurin's formula. Problems and Exercises based on these topics to be done as tutorials.

Text Books:

1. S.S. Sastry, *Introductory methods of Numerical Analysis, Prentice Hall of India,* Private Limited, 2005.

Reference Books:

1. B.S. Grewal, *Numerical Methods in Engineering and Science,* Khanna Publishers , 2010.
2. B. Braide,*A Friendly Introduction to Numerical Analysis,* Pearson Education, India, 2007.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VI
(Examination to be held in May 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-603
Course Title: Basic Complex Analysis
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

De-Moivre's Theorem, Applications of De-Moivre's Theorem in finding the roots of complex numbers, solutions of polynomial equations, expressing sines and cosines in terms of sines and cosines of multiples of angle and vice-versa. Problems and Exercises based on these topics to be done as tutorials.

Unit-II

Function of complex variable: Exponential Functions, Logarithmic Functions, Circular and Hyperbolic Functions, Inverse Circular Functions, relation between them and their properties. Problems and Exercises based on these topics to be done as tutorials.

Unit-III

Limits, Continuity, regions in the complex planes, mapping and differentiability, Cauchy-Riemann equations, Sufficient condition for differentiability. Problems and Exercises based on these topics to be done as tutorials.

Unit-IV

Analytic Functions, examples of analytic functions, Cauchy-Riemann equations and its polar form, Necessary and sufficient condition for analyticity, harmonic function, construction of analytic function. Problems and Exercises based on these topics to be done as tutorials.

Text Books:

1. T. Gamelin, *Complex Analysis,* Springer.

Reference Books:

1. J. W. Brown and R. V. *Churchill, Complex variables and applications,* McGraw-Hill Higher Education.
2. L. Ahlfors, *Complex Analysis,* McGraw-Hill Book Company.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VI
(Examination to be held in May 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-604
Course Title: Graph Theory
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Graphs, Applications of graphs, finite and infinite graphs, Incidence and degree, Isomorphism, Subgraphs, Walks, paths and circuits, connected graphs, disconnected graphs and components.Exercises and examples based on these topics.

Unit-II

Bipartite graph, Degree-sum formula, Graphic Sequences,Euler Graphs, Operations on graphs, More on Euler graphs, Hamiltonian paths and circuits. Exercises and examples based on these topics.

Unit-III

Trees, some properties of trees, Pendant vertices in a tree, Distance and centers in a tree, Enumeration of Trees, Spanning trees, Weighted graphs, Spanning trees in a weighted graph.Exercises and examples based on these topics.

Unit-IV

Cut-sets,some properties of cut-sets, All cut-sets in a graph, Fundamental circuits and cut-sets, Connectivity and separability, Homeomorphism of graphs, Planar graphs, Kuratowski's two graphs, Different representations of a planar graph. Exercises and examples based on these topics.

Text Books:

1. Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science,* PHI Learning Pvt. Ltd, Delhi, 2019.

Reference Books:

1. D.B. West, *Introduction to Graph Theory,* Prentice Hall, 2001
2. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, Springer-Verlag New York, 2012.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VI
(Examination to be held in May 2025, 2026, 2027)
Minor Course

Course Code: UMIMAT-605
Course Title: Numerical Analysis
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Finite differences, the operators Δ, ∇, E, D, and relations between them, separation of symbols. Interpolation: Linear and quadratic interpolation. Newton's forward and backward differences interpolation formula. Problems and Exercises based on these topics to be done as tutorials.

Unit-II

Central differences, Gauss's forward and backward interpolation formulas, Sterling's formula, Bessel's formula, Lagrange's interpolation formula (inverse interpolation). Problems and Exercises based on these topics to be done as tutorials.

Unit-III

Numerical Differentiation: Forward, backward and central difference formulas for numerical differentiation, maxima and minima of a tabulated function. Problems and Exercises based on these topics to be done as tutorials.

Unit-IV

Numerical Integration: Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's $\frac{1}{3}$ and $\frac{3}{8}$ rule, Boole's rule, Maclaurin's formula. Problems and Exercises based on these topics to be done as tutorials.

Text Books:

1. S.S. Sastry, *Introductory methods of Numerical Analysis, Prentice Hall of India,* Private Limited, 2005.

Reference Books:

1. B.S. Grewal, *Numerical Methods in Engineering and Science,* Khanna Publishers , 2010.

2. B. Braide,*A Friendly Introduction to Numerical Analysis,* Pearson Education, India, 2007.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VII
(Examination to be held in December 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-701
Course Title: Topology I
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Topological spaces, basis and subbasis for a topology, order topology, product topology of $X \times Y$, Subspace topology, closed sets and limit points, closure and interior sets, Hausdorff space. Problems and exercises based on these concepts.

Unit-II

Continuous functions, homeomorphisms, the pasting lemma, product topology, box topology, uniform topology and their relationships, Quotient topology, Quotient spaces. Problems and exercises based on these concepts.

Unit-III

Metric topology, metrizable spaces, the sequence lemma, Uniform limit theorem, connectedness, path connectedness, components and local connectedness. Problems and exercises based on these concepts.

Unit-IV

Compact spaces, compact subspaces of a real line, uniform continuity theorem, finite intersection property, limit point compactness, sequential compactness, nets and filters, their convergence, subnets and cluster points. Problems and exercises based on these concepts.

Text Books:

1. J. R. Munkres, *Topology*, Pearson Education India, 2013.

Reference Books:

1. M. H. A. Newman,*Elements of the Topology of Plane Sets of Points,* 2nd edition, Cambridge University Press, 1951.
2. S. Willard, *General Topology*, Addison Wesley, 1970.

3. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw-Hill Education, 1963.

4. J. Dugundji, *Topology,* Allyn and Bacon, 1966.

5. J. L. Kelly, *General Topology,* Springer Science and Business Media, 1975.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.
(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VII
(Examination to be held in December 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-702
Course Title: Measure Theory
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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.

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

σ-algebra of sets, limit of sequences of sets, Generation of algebras, Borel σ-algebra, G_δ and F_δ sets, Measure on σ-algebra, 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 invariance 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 exercise on these topics.

Unit-III

Measurable functions, Operation with measurable function, equality a.e., sequence of measurable functions, continuity and Borel Lebesgue measurability of function 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.

Unit-IV

Convergence a.e., Almost uniform convergence, Ergroff'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:

1. J. Yeh, *Lectures on real Analysis*, World Scientific, 2000.

Reference Books:

1. M. E. Munore, *An Integration*, Addison Wesley, 1971.

2. G. D. Barra, *Measure Theory and Integration,* Willey Eastern 1987.

3. H. L. Royden, *Real Analysis*, 3rd edition, Macmilon, New York, 1988.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VII
(Examination to be held in December 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-703
Course Title: Differential Geometry
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

Objectives: Being a fundamental course, this course aims at preparing students to realise and do mathematics geometrically by understanding curves, surfaces and geodesics.

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

Curves: Differentiable curves, arc length, parametrization by arc length, plane curves, plane curvature, Directed curvature, Fundamental Theorems for plane curves. Curves in space: Tangent, normal and binormal unit vectors, curvature and torsion, Oriented Serret frame, Fernet-Serret theorem. Fundamental Theorem for curves in $\mathbb{R}^3$. Properties of curves such as Helix, Bertrand involute curves on sphere.

Unit-II

Surfaces: A regular surface, examples, coordinate charts, change of coordinate, differentiable functions, diffeomorphism, tangent plane, unit normal vector, oriented surfaces, first fundamental form, element of arc length, invariance of line element under coordinate change, angle between two curves, orthogonal parametrization, Area, curvature for surfaces, Euler's work on surfaces, Principle curvatures, line of curvature. Rodrigue's formula, Gauss map, second fundamental form. Meusiner's theorem, Gaussian curvature, Dupin indicatrix.

Unit-III

Metric Equivalence of Surface: Isometry, local isometry, Christoffel symbols, Theorema Egreguem, Gauss equations, Mainardi-Codazzi equations, Statement of Fundamental theorem for regular surfaces, Line of curvature, asymptotic line, special, Geodesic curvature.

Unit-IV

Geodesics: Local distance, minimizing properties of geodesics, exponential map, Hopf-Rinow Theorem, Statement of Hopf's Umlaufsatz, Gauss-Bonnet Theorem, Some applications of Gauss-Bonnet Theorem.

Text Books:

1. John McCleary, *Geometry From a Differentiable Point of View,* Cambridge University Press, 1994.

Reference Books:

1. D. T. Struik, *Differential Geometry*, Addison Wesley, 1961.
2. N. Parkash, *Differential geometry*, Tata MacGraw Hill, Publication Company, New Delhi.
3. W. Klingenberg, *A course in Differential Geometry*, Springer-Verlag, New York, 1976.
4. M. Do Carmo, *Differential Geometry of Curves and surfaces,* Prentince Hall Englewood Cliff's, N. J. 1976.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VII
(Examination to be held in December 2025, 2026, 2027)
Major Course

Course Code: UMJMAT-704
Course Title: Commutative Algebra
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

Objectives: This course includes the preliminary study of modules. A ring R will always mean a commutative ring with unity.

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

Review of Rings and Ideals. R-modules, submodules, R-module homomorphism and isomorphism, Quotient module, Kernel of R-module homomorphism, Submodule generated by N and K, where N is a submodule of M and K is a submodule of N, Cyclic R-module, Annihilator of an R-module, Faithful R-module, Finitely Generated R-module, Direct Sum of R-modules, Free Modules. Examples and exercises based on these concepts.

Unit-II

Review of PID, Exact Sequence, Split exact sequence and related results; Projective R-modules and their properties; Finitely generated and Finitely presented R-module, Shaneul's Lemma. Examples and exercises based on these concepts.

Unit-III

R-bilinear map, Tensor Product of two R-modules and their properties, Existence and Uniqueness of Tensor product of two R-modules, Behaviour of Tensor product with respect to exact sequences; Flat R- modules, Faithfully Flat R-modules and related results. Examples and exercises based on these concepts.

Unit-IV

Review of Prime and Maximal Ideals, Prime Avoidance Theorem; Nilpotent elements, Nil radical of R, Nil radical of R as the intersection of all prime ideals of R; Jacobson radical of R, characterization of an element of Jacobson radical of R; Comaximal Ideals, Chinese Remainder Theorem and related results; Radical of an ideal I of R ($\sqrt{I}$), $\sqrt{I}$ as the intersection of all prime ideals containing I. Examples and exercises based on these concepts.

Text Books:

1. NS Gopala Krishnan, *Commutative Algebra* (Second Edition) University Press (India) Private Limited.

Reference Books:

1. Andrea Ferreti, *Commutative Algebra,* Graduate studies in Mathematics, AMS.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.
(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VII
(Examination to be held in December 2025, 2026, 2027)
Minor Course

Course Code: UMIMAT-705
Course Title: Optimization Theory
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

Objectives: The main objective of the course is to formulate mathematical models and to understand solution methods for real life optimal decision problems. The emphasis will be on basic study of linear programming problem, Integer programming problem, Transportation problem, Two person zero sumgames with economic applications.

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

Sequences and Subsequences, Mapping and functions, Continuous functions, Infimum and Supremum of functions, Minima and maxima of functions, Differentiable functions. Vectors and vector spaces, Matrices, Linear transformation, Quadratic forms, Definite quadratic forms, Linear equations, Solution of a set of linear equations, Basic solution and degeneracy.

Unit-II

Convex sets and Convex cones, Introduction and preliminary definition, Convex sets and properties, Convex Hulls, Extreme point, Separation and support of convex sets, Convex Polytopes and Polyhedra Convex cones, Convex and concave functions, Basic properties, Differentiable convex functions, Generalization of convex functions.

Unit-III

Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Two phase method, Big M method, Exceptional cases in LP, Duality theory, Dual simplex method. Integer Programming: Branch and bound technique.

Unit-IV

Transportation and Assignment Problem: Initial basic feasible solutions of balanced and unbalanced transportation/assignment problems, Optimal solutions, Travelling salesman problem. Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solutionby linear programming.

Text Books:

1. Swarup, K., Gupta, P. K., Manmohan, *Operations Research,* Sultan Chand and Sons, (2010).

2. Taha H. A., *Operations Research An Introduction,* PHI (2007).

Reference Books:

1. S. S. Rao, *Engineering Optimization. Theory and Practice;* Revised 3rd Edition, New Age International Publishers, New Delhi.

2. G. Hadley, *Linear Programming,* Addison Wesley.

3. N. S. Kambo, *Mathematical Programming Techniques,* East West Press, 1991.

4. S. Chandra Jayadeva, A. Mehra, *Numerical Optimization and Applications,* Narosa Publishing House, (2013).

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Major Course

Course Code: UMJMAT-801
Course Title: Complex Analysis
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

Objectives: The main objective of this course is to study some advance topics in Complex 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

Spherical representation of complex numbers and the extended complex plane, real differentiability, the functions f_z and $f_{\bar{z}}$.
Complex Integration: Paths in the Complex Plane, Smooth and Piecewise Smooth Paths, Parametrizing of Paths, Change of parameter, Integral Along Paths, Complex Line Integrals, Properties of Contour Integrals and Primitives, Rectifiable Paths, Integral Along Rectifiable Paths. Examples and Exercises based on these topics.

Unit-II

Cauchy Theorem for a rectangle, Integral and Primitives, Cauchy Theorem for a disk. Winding numbers, Oriented Paths, Jordon Contours, the Cauchy Integral formula, the Cauchy Integral Formula for higher deerivatives-analyticity of derivatives. Derivatives Estimates. Maximum Principle, Schwarz Lemma and Hadamard Three Circle theorem. Simply Connected Domains, Simple Connectivity, Primitives and Logarithms.

Unit-III

Sequences and Series of Analytic Functions: Uniform convergence and normal convergence, general results, Taylor's series, Laurent's series and Laurent's Theorem. Zeros of analytic functions, classification of isolated singularities of analytic functions-removable singularity, pole and essential singularity and singularity at infinity. Cauchy Residue Theorem and evaluating integrals with Cauchy Residue theorem, Consequences of Cauchy Residue Theorem.

Unit-IV

Conformal Mappings: Curvilinear angles, Diffeomorphisms, Conformal Mapping, Some standard Conformal Mappings, Self-mappings of the Plane and the Unit disk, Conformal Mappings in the Extended Plane. Mobius Transformations: Elementary Mobius Transformations, Mobius Transformation and

mtarices, Fixed points, Cross-Ratios, Circle in the Extended Plane. reflection and symmetry, classification of Mobius transformations and Invariant Circles.

Text Books:

1. Bruce P. Palka, *An introduction to Complex Function Theory*, Springer Science -Business Media, New York, 1991.

Reference Books:

1. Lars V. Ahlfors, *Complex Analysis,* McGraw-Hill International Editions, 1979.
2. John B. Conway, *Functions of One Complex Variable,* Narosa Publishing House, 1990.
3. T. W. Gamelin, *Complex Analysis*, Springer, 2001.
4. S. Ponnusamy and Herb Silverman, *Complex Variables with Applications,* Birkhauser, 2006.
5. Serge Lvovski, *Principles of Complex Analysis,* Springer, 2020.
6. Reinhold Remmert, *Theory of Complex Functions,* Springer, 1991.
7. Steven G. Krantz, *Complex Variables,* Chapman and Hall-CRC, 2008.
8. Joseph L. Taylor, *Complex Variables,* American Math. Soc., 2011.
9. Elias M. Stein and Rami Shakarchi, *Complex Analysis,* Princeton University Press, 2003.
10. Zeev Nihari, *Conformal Mappings,* Dover Publications Inc. New York, 1975.
11. Robert B. Ash and W. P. Woringer, *Complex Analysis,* Dover Publications, 2007.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Major Course

Course Code: UMJMAT-802
Course Title: Functional Analysis
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, **Theory:** 75, **Tutorial:** 25

Objectives: This course aims at familiarizing the students with the geometry of metric spaces, Banach Spaces and Hilbert spaces. Some fundamental theorems in functional analysis like Banach contraction Principle, Hahn-Banach Theorem, uniform boundedness principle are included in the syllabus. These theorems have immense applications in several branches of Mathematics and Mathematical physics. A preliminary knowledge of modern algebra, Real and Complex analysis, General topology and measure theory is essential for smooth sailing in this course.

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

Definition of metric spaces, convergence complete metric spaces, Banach contraction Principle and its applications to differential and integral equations, completion theorem, category theorem and its applications, compactness , Arzela-Ascoli's Theorem, Problems and examples based on these concepts.

Unit-II

Normed linear spaces and Banach spaces, examples, finite dimensional normed linear spaces, equivalent norms quotient spaces, F. Riesz's lemma , Bounded linear operators, examples, dual spaces, computation of duals of IR, $l_p, 1 \leq p < \infty$ and Co.

Unit-III

Hahn-Banach Theorem in real, Complex and linear spaces and applications, reflexive spaces, uniform boundedness principle, open mapping theorem, Bounded inverse-theorem, closed graph theorem.

Unit-IV

Inner product spaces, the Cauchy-Schwartz inequality, the Phythagorean Theorem, Hilbert spaces, examples of Hilbert spaces. Orthognal complement and direct sum, minimizing vector theorem, projection theorem, orthonormal sets, Bessel's inequality orthonormal basis, the existence of orthonormal basis Riez representation theorem, the dimension of Hilbert spaces. Adjoint of a linear operator, self adjoint, normal and unitary operators.

Text Books:

1. C. Goffman and G. Padrick, *First course in Functional Hall Analysis,* Prentice 1955.(for unit -1).

2. E. Kreyszig, *Introductory Functional Analysis with Applications*, John Wiley and Sons 1978. (For unit- II, III and IV)

Reference Books:

1. R. G. Douglas, *Banach Algebra Techniques in operator Theory,* Springer-Verlag, New York 1998.

2. J. B. Conway, *A course in Functional Analysis,* Springer Verlag, 1973.

3. B. V. Limaye, *Functional Analysis,* Wiley Eastern Ltd. 1981.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.
(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Major Course

Course Code: UMJMAT-803
Course Title: Cryptography
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

Objectives: Discuss about various encryption techniques. Understand the concept of public key Cryptography. Introduce message authentication and hash function. Provide Lab sessions for each unit to help gain deeper insight into Cryptography.

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

Introduction to cryptography, cryptanalysis, and cryptology, Overview of cryptography, Basic Cryptographic primitives, Classical ciphers: substitution cipher-Caesar, Playfair and Hill cipher, Transposition cipher - Rail fence, Columnar and Double columnar, Cryptanalysis of classical ciphers, Introduction to probability, Conditional probability, Law of Total probability, Shannon's theorem, One-time-pad encryption, Limitations of One-Time-Pad. Algebraic structures - Rings, Fields and groups.

Unit-II

Introduction to symmetric key cryptography, Pseudo Random Numbers, Feistel Cipher, S-box and E-box, Initial and Final permutations, Data Encryption Standard (DES), Cryptanalysis and avalanche effect, AES (Advanced Encryption Standard), Key Scheduling, Side channel attacks, Block and Stream ciphers.

Unit-III

Introduction to Public key cryptography, Modes of operation, Prime number, Primitive root, Modular arithmetic, Polynomials, Diffie Hellman Protocol(DH Protocol), Elgamal crypto systems, Prime Factorization, Rivest-Shamir-Adleman cryptosystem (RSA).

Unit-IV

Key management and distribution (KDC), Birthday attack, Entity authentication methods, password, challenge response, Zero knowledge protocols, message digest algorithm (MD5), One-way function, Collision resistant hash function (CRHF), Secure Hash Algorithm (SHA), Applications.

Text Books:

1. J. Katz and Y. Lindell,*Introduction to Modern Cryptography*, 2nd Edition, CRC Press, 2015.

Reference Books:

1. B. A. Foruzan, *Cryptography and Network Security*, 3rd Edition, Tata McGraw Hill, 2017.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.
(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Major Course

Course Code: UMJMAT-804
Course Title: Fluid Dynamics
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Types of fluids, Lagrangian and Eulerian method of describing fluid motion, most general motion of the fluid element: translation, rotation and deformation. Stream lines, path lines and streak lines, material derivative, acceleration components of fluid particle in cartesian, cylindrical and spherical polar coordinates (without proof), vorticity vector, vortex lines, rotational and irrotational motion.

Unit-II

Velocity, potential boundary surface, boundary condition. Irrotational motion in two-dimensional, stream functions, complex velocity potential, sources, sinks, doublets and their images in two dimensional. Continuum hypothesis, Newton's law of viscosity, some cartesian tensor notations.

Unit-III

Stress Analysis: Stress at a point, Stress in a fluid at rest, Stress in a fluid in motion, Relation between stress and rate of strain components (Stokes' Law of Friction), Thermal conductivity, Generalized law of heat conduction. Fundamental Equations of the flow of viscous fluids: Introduction, Equation of State, Equation of continuity, Equations of motion (Navier-Stokes Equations), Equation of energy, Vorticity and Circulation (Kelvin's Circulation Theorem).

Unit-IV

Dynamical similarity (Reynolds law), Inspection analysis, Dimensional analysis, Buckingham π theorem and its application, π product and coefficients, Non-dimensional parameter and their physical importance. Exact solution of the $N - S$ Equations, Steady motion between the parallel plates (a) velocity distribution, (b) Temperature distribution, Plane couette flow, Plane Poiseuille flow, Generalized plane Couette flow. Flow in a circular pipe (Hagen-Poiseuille flow) (a) Velocity distribution, (b) temperature distribution. Theory of very slow motion: Flow past a sphere (Stokes and Oseen flow).

Text Books:

1. J. L. Bansal, *Viscous fluid dynamics,* Oxford and IBH Publishing Company Pvt. Ltd., (1977).

2. F. Chorlton, *Text book of fluid dynamics,* CBS Publishers and distribution (2000).

Reference Books:

1. G. K. Batchelor,*An introduction to fluid dynamics,* Cambridge University press, (1970).

2. C. S. Yih, *Fluid Mechanics,* McGraw-Hill Book Company.

3. S. W. Yuan, *Foundation of Fluid Mechanics,* PHI Pvt Ltd. New Delhi (1969).

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Major Course

Course Code: UMJMAT-805
Course Title: Topology-II
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

Objectives: The objective of this course is to introduce and explore advanced topology such as countability axioms,separation axioms, Urysohn lemma, the Urysohn Metrization Theorem, the Tietze extension theorem, local compactness, one-point compacification, Ascoli's theorem and Baire spaces.

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

The countability axioms, the separation axioms, Normal spaces, the Urysohn Lemma, the Urysohn Metrization Theorem, the Tietze extension Theorem, m-manifolds, Imbedings of Manifolds, Theorem on existence of finite partitions of Unity. Problems and exercise based on these concepts.

Unit-II

Local compactness, one-point compacification, the Tychnoff theorem for finite products, Tychnoff's Theorem for arbitrary products, Stone-Cech compactification, applications of the Tychnoff theorem, Local finiteness, paracompactness, metrizable space, metrization theorem, the Nagata-Smirnov metrization theorem and the Smirnov metrization theorem. Problems and exercise based on these concepts.

Unit-III

Complete Metric Spaces, uniform metric, sup metric, Completeion of metric space, a space-filling curve, compactness in metric spaces, equicontinuity, classical version of Ascoli's theorem, pointwise and compact convergence, evaluation map, Ascoli's theorem. Problems and exercise based on these concepts.

Unit-IV

Baire spaces, the Baire category theorem, applications of the Baire category theorem, a nowhere-differentiable function, m-manifolds, topological dimension, imbedding theorem. Problems and exercise based on these concepts.

Text Books:

1. J. R. Munkres, *Topology*, Pearson Education India, 2013.

Reference Books:

1. J. R. Munkres, *Topology of Manifolds*, Westview Press, 1991.
2. S. Willard, *General Topology*, Addison Wesley, 1970.
3. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw-Hill Education, 1963.
4. G. E. Bredon, *Topology and Geometry*, Springer, 1993.
5. J. Dugundji, *Topology,* Allyn and Bacon, 1966.
6. J. L. Kelly, *General Topology,* Springer Science and Business Media, 1975.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Minor Course

Course Code: UMIMAT-806
Course Title: Partial Differential Equation
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Introduction to Partial Differential Equations, order and degree of a partial differential equation, Formation of a partial differential equation by eliminating arbitrary constants and functions, types of partial differential equations, Lagrange's method of solving partial differential equation of order one. Problems and Exercises based on these topics to be done as tutorials.

Unit-II

Non linear partial differential equation of degree one. Complete integral, singular integral, general solution, Charpit's method and solution of equation of the type $f(p,q) = 0$, $z = p + q + f(p,q)$ and $f(x,p) = g(y,q)$. Problems and Exercises based on these topics to be done as tutorials.

Unit-III

Homogeneous and Non-Homogenous linear partial differential equations of 2nd and 3rd order with constant coefficients of the type $F(D,D') = g(x,y)$, where $g(x,y) = 0$, $e^{(}ax+by)$, $Cos(ax+by)$, $sin(ax+by)$, $f(ax+by)$, $x^m y^n$, $Ve^{(}ax+by)$. Homogeneous partial differential equation of the type $[(D + m_1D')(D + m_2D')(D + m_3D')]z = f(x,y)$. Problems and Exercises based on these topics to be done as tutorials.

Unit-IV

Classification of second order partial differential equation, Canonical forms, Canonical form of hyperbolic, parabolic and elliptic equations. Solutions of heat and wave equations by separation of variables, Dirchlet problem for a rectangle. Problems and Exercises based on these topics to be done as tutorials.

Text Books:

1. I. N. Sneddon, *Elements of partial differential equations,* McGraw-Hill International Editions.

Reference Books:

1. K. Sankara Rao, *Introduction to partial differential equation,* Prentice Hall of India Pvt. Ltd. 2007

2. M. D. Raisinghania, *Ordinary and partial differential equations,* S. Chand and co. 2020

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

SEMESTER VIII
(Examination to be held in May 2026, 2027, 2028)
Major Course

Course Code: UMJMAT-807
Course Title: Research Methodology
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100**, Theory:** 75**, Tutorial:** 25

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

Overview of research process: Meaning of research, various approaches of research, significance of research, parameter of good research, developing the objectives, preparing the Research Design.

Unit-II

Literature survey, What is literature survey? Functions of literature survey Searching for Publications, Publication databases, search engines and Online tools-Open sources, open access Journals, (other important websites, groups and societies). Subscribed sources, IEEE Springer link, Sci av direct, AMS. LMS, JSTOR INFLIB NET) Survey papers. Math Sci Net, use of scientific workplace, MATLAB/MATHEMATICA for scientific calculations and visualization of data.

Unit-III

LaTeX for typesetting-How to write a mathematics document in LaTeX. Understanding the key research area of interest. Conditions and Steps in selecting a research problem, Sources of research problem: Creative thinking techniques, Study of research gaps, Critical reading of research papers formulating the research problem and writing the synopsis, Method of writing a good research paper, publishing a research paper.

Unit-IV

Commercialization, Copy Right, Reproduction of published material, Plagiarism, Citation and acknowledgment, Reproducibility and account ability standards of quality (Refereed, indexed, impact factor paper citation Index etc.) Indexing databases (Math sci net, ZB Math, AMS Mathematical Reviews, Scopus etc.), Critical evaluation of standards of quality. Preparing seminar presentation, Preparing research report, Preparing bibliography (various styles).

Text Books:

1. A. Gilat, *MATLAB, An Introduction With Applications,* Wiley India Edition.

Reference Books:

1. C. Hastings, K. Mischo, M. Morrison,*Hands-On Start to Wolfram Mathematica*, Wolfram Media Inc. 2015.
2. G. Gratzer, *More Math into LaTeX*(4th Edition), Springer 2007.
3. C. R. Kothari, G. Garg, *Research Methodology, Methods and Techiniques*, (Third Edition) New Age International Publishers.
4. Dr. Pramod Kumar Naik, Dr. Pushkar Dubey,*Research Methodology*, APH Publishing Corporation.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

UNIVERSITY OF JAMMU

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

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(23/May/Adp./37)

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 Syllabi and Courses of Study in the subject of **Mathematics** of Semesters **IIIrd** and **IVth** for **Four Year Under Graduate Programme** under the **Choice Based Credit System** as per **NEP-2020 (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-III Semester-IV	December 2023, 2024 and 2025 May 2024, 2025 and 2026

The Syllabi of the courses is available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/23/3408-3418
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.

Sumitra Sharma
Deputy Registrar (Academic)
24/5/23

Semester – III

SEMESTER III (MATHEMATICS)

4 Credits Courses

S.No.	Course Type	Course No.	Course Title	Credits	Marks				Total Marks
					Theory:75		Tutorial:25		100
					Mid Sem Exam	End Sem Exam	Assessment	Exam	
1.	Major	UMJMAT301	Real Analysis-I	4	15 marks	60 marks	10 marks	15 Marks	
2.	Major	UMJMAT302	Partial Differential Equations	4					
3.	Minor	UMIMAT303	Real Analysis	4					

3 Credits Courses

S.No.	Course Type	Course No.	Course Title	Credits	Total Marks		Total marks
					Theory		75
1.	MD	UMDMAT304	Foundations of Mathematics	3	Mid Semester: 15 marks	End Semester: 60 marks	
2.	AE	UAEMAT306	Linear Programming	3			

2 Credits Courses

S.No.	Course Type	Course No.	Course Title	Credits	Total Marks		Total marks
					Theory	Practical	50
1.	SE	USEMAT305	LATEX	2	Mid Semester: 10 marks End Semester: 20 marks	20 marks	

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SEMESTER III
(Examination to be held in December 2023, 2024, 2025)
Major Course

Course Code: UMJMAT301
Course Title: Real Analysis-I
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: The main objective of this course is the study of sequences and series of real numbers.

Prerequisite of this course: UMJMAT101 and UMJMAT201

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

Finite and infinite sets. Intervals. Countable and uncountable sets, Absolute value and the Real line. Triangular Inequality, Bounded and unbounded sets, Supremum and infimum of sets, Least upper bound and greatest lower bound, $\mathbb{R}$ as a complete ordered field, Existence of rationals and irrationals between reals. Examples and Exercises based on these topics-to be done as tutorials.

Unit-II

Definition of real sequences, Limit of a sequence, Convergence, boundedness and divergence of sequences, Oscillatory and monotone sequences, Uniqueness of a limit. Operations on convergent and divergent sequences. Monotone Convergence Theorem and its applications to the calculation of square root of positive numbers, Sequeezing Principle. Examples and Exercises based on these topics-to be done as tutorials.

Unit-III

Subsequences and Bolzano-Weierstrass Theorem, Cauchy Sequences, Cauchy's General Principle of Convergence, Nested Interval Theorem, Contractive Sequences. Examples and Exercises based on these topics-to be done as tutorials.

Unit-IV

Infinite series and their convergence and divergence, Cauchy's Criterion for series, Conditional and absolute convergence, Geometric series test, p-series test, comparison tests, D'Alembert's ratio test, Cauchy's root test, Raabe's test, Gauss test (without proof). Examples and Exercises based on these topics-to be done as tutorials.

Text Books:

1. Robert G. Bartle and Donald R. Sherbert. *Introduction to Real Analysis*, Wiley India Edition, 2011.
2. Richard R. Goldberg. *Methods of Real Analysis*, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

Reference Books:

1. S.C. Malik and Savita Arora, *Mathematical Analysis*, New Age International Publisher, 1982 (2020 reprint).
2. Sudhir R. Ghorpade , Balmohan V. Limaye, A Course in Calculus and Real Analysis, Springer, 2018.
3. Walter Rudin, *Principles of Mathematical Analysis*, 3rd Edition, McGraw-Hill International Editions, 1976.
4. Tom M. Apostol. *Mathematical Analysis*, Narosa Publishing House, 1985.
5. Charles G. Denlinger, *Elements of Real Analysis*, Jones and Bartlett India Pvt. Ltd, 2011.
6. Houshang H. Sohrab, *Basic Real Analysis*, Birkhauser, 2003.
7. H. Protter, *Basic Elements of Real Analysis*, Springer, 1998.
8. Stevan G. Krantz, *Real Analysis and Foundations*, CRC Press, 2000.
9. William R. Parzynski and Philip W. Zipse, *Introduction to Mathematical Analysis*, McGraw-Hill International Editions, 1987.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

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SEMESTER III
(Examination to be held in December 2023, 2024, 2025)
Major Course

Course Code: UMJMAT302
Course Title: Partial Differential Equations Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: This course aims at gaining a clear intuitive understanding of the concept of partial differential equation and its relevance in describing physical phenomena such as diffusion and wave propagation, and to learn the separation of variables method to solve linear parabolic, elliptic and hyperbolic partial differential equations.

Prerequisite of this course: UMJMAT101 and UMJMAT201

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

Introduction to Partial Differential Equations, order and degree of a partial differential equation, Formation of partial differential equations by eliminating arbitrary constants and functions, types of partial differential equations, Lagrange's method of solving partial differential equations of order one. Examples and Exercises based on these topics-to be done as tutorials.

Unit-II

Nonlinear partial differential equations of degree one. Complete integral, singular integral, general solution, Charpit's method and solution of equations of the type $f(p,q) = 0$, $z = px + qy + f(p,q)$, and $f(x,p) = g(y,q)$. Examples and Exercises based on these topics-to be done as tutorials.

Unit-III

Homogenous and Non-Homogenous linear partial differential equations of 2nd and 3rd order with constant coefficients of the type $F(D,D') = g(x,y)$, where $g(x,y) = 0, e^{ax+by}$, $sin(ax+by)$, $cos(ax+by)$. $f(ax+by)x^m y^n, Ve^{ax+by}$. Homogenous partial differential equation of the type

$$[(D + m_1D')(D + m_2D')(D + m_3D')]z = f(x,y).$$

Examples and Exercises based on these topics-to be done as tutorials.

Unit-IV

Classification of second order partial differential equation, Canonical form, Canonical form of hyperbolic, parabolic and elliptic equations. Solution of heat and wave equations by separation of variables, Dirichlet problem for a rectangle, Neumann problem for a rectangle. Examples and Exercises based on these topics-to be done as tutorials.

Text Book:

K. Sankara Rao, *Introduction to Partial Differential Equations,* Prentice Hall of India Pvt. Ltd. 2007.

Reference Books:

1. I. N. Sneddon, *Elements of Partial Differential Equations,* McGraw-Hill International Editions.
2. T. Hillen, I. E. Leonard and H. Van Roessal, *Partial Differential Equations,* Wiley- AJohn Wiley and Sons Inc. Publications, 2012.
3. M.D. Raisinghania, *Ordinary and Partial Differential Equations,* S. Chand and Co., 2020.
4. E. G. Petrovsky, *Lectures on Partial Differential Equations,* Dover Publication Inc. 1991.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

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SEMESTER III
(Examination to be held in December 2023. 2024, 2025)
Minor Course

Course Code: UMIMAT303
Course Title: Real Analysis
Credits: 04
Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: The main objective of this course is the study of sequences and series of real numbers.

Prerequisite of this course: UMJMAT101 and UMJMAT201

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

Finite and infinite sets, Intervals, Coutable and uncountable sets, Absolute value and the Real line. Triangular Inequality, Bounded and unbounded sets, Supremum and infimum of sets, Least upper bound and greatest lower bound, $\mathbb{R}$ as a complete ordered field, Existence of rationals and irrationals between reals. Examples and Exercises based on these topics.

Unit-II

Definition of real sequences, Limit of a sequence, Convergence, boundedness and divergence of sequences, Oscillatory and Monotone sequences. Uniqueness of a limit. Operations on convergent and divergent sequences. Monotone Convergence Theorem and its applications to the calculation of square root of positive numbers, Sequeezing Principle. Examples and Exercises based on these topics-to be done as tutorials.

Unit-III

Subsequences and Bolzano- Weierstrass Theorem, Cauchy Sequences, Cauchy's General Principle of Convergence, Nested Interval Theorem, Contractive sequences. Examples and Exercises based on these topics-to be done as tutorials.

Unit-IV

Infinite series and their convergence and divergence, Cauchy's Criterion for series, Conditional and absolute convergence, Geometric series test, p-series test, comparison tests, D' Alembert's ratio test, Cauchy's root test, Raabe's test,

Gauss test (without proof). Examples and Exercises based on these topics-to be done as tutorials.

Text Books:

1. Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis,* Wiley India Edition, 2011.
2. Richard R. Goldberg, *Methods of Real Analysis,* Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Reference Books:

1. S.C. Malik and Savita Arora, *Mathematical Analysis,* New Age International Publisher, 1982 (2020 reprint).
2. Walter Rudin, *Principles of Mathematical Analysis,* 3rd Edition. McGraw-Hill International Editions. 1976.
3. Tom M. Apostol. *Mathematical Analysis.* Narosa Publishing House, 1985.
4. Charles G. Denlinger. *Elements of Real Analysis,* Jones and Bartlett India Pvt. Ltd, 2011.
5. Houshang H. Sohrab, *Basic Real Analysis,* Birkhauser, 2003.
6. H. Protter, *Basic Elements of Real Analysis,* Springer, 1998.
7. Stevan G. Krantz, *Real Analysis and Foundations,* CRC Press, 2000.
8. William R. Parzynski and Philip W. Zipse, *Introduction to Mathematical Analysis,* McGraw-Hill International Editions, 1987.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to

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be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

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SEMESTER III

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

Multidisciplinary Course

Course Code: UMDMAT304
Course Title: Foundations of Mathematics
Credits: 03 **Total Number of Lectures: Theory: 45**
Maximum Marks: 75,

Objectives: The objectives of the course is to introduce the students to the language of mathematics-the language to know the nature, As Mathematics has vast range of applications to almost all disciplines of learning and evolves the critical thinking develops a logical and rational approach towards the solutions of problems. learning of the basic mathematics is indispensable for for the creation of critical and logical thinkers, that's why this course is designed.
Structure of the Course: This course is divided into four units of 45 lectures in total: tentative number of lectures required for each unit is indicated against each unit. wherein one lecture is of one hour duration.

Unit-I (12 Lectures)

Propositions. truth values and truth tables, negation, conjunction and disjunction, implications, bi-conditional propositions, converse, contrapositive and inverse propositions, propositional equivalence: logical equivalences, predicates and quantifiers, tautology and contradiction. Analysis of arguments. Examples and exercises on these topics.

Unit-II (12 Lectures)

Sets, subsets, set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets, finite sets and counting principle, power set, classes of sets. Difference and symmetric difference of two sets, set identities, generalized union and intersections with laws. Examples and exercises on these topics.

Unit-III (12 Lectures)

Cartesian product of sets, relation between sets, types of relation. partition of a set, fundamental theorem of equivalence relation(statement only). Functions: Basic definitions, injective function, surjective function. bijective function, composition of functions, inverse of a function. Examples and exercises on these topics.

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Unit-IV (09 Lectures)

Prime numbers. GCD, LCM, division algorithm, relation between GCD and LCM, principle of mathematical induction. Examples and exercises on these topics.

Text Book: Steve Warner, *Pure Mathematics for Beginners*, Get 800 LLC, 2018.

Reference Books:

1. Shobha Bagai, Amber Habib and Geetha Venkataraman, *A Bridge to Mathematics*, Sage Publications India Pvt Ltd., 2017.
2. David M. Burton, *Elementary Number Theory*, McGraw Hill Education, 2017.
3. Paul R. Halmos, *NaÃ¯ve Set Theory*, Springer, 1998.
4. K. Devlin, *The Joy of Sets: Fundamentals of Contemporary Set Theory*, Undergraduate Texts in Mathematics, 2nd Edition, New York, Springer. 1993.
5. *NCERT Textbook of Mathematics for Class XI*, Jammu and Kashmir State Board of School Education, 2022.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus, there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

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SEMESTER III

(Examination to be held in December 2022. 2023, 2024)

Skill Enhancement Course

Course Code: USEMAT305
Course Title: $LATEX$
Credits: 02
Total Number of Lectures:30, Theory: 15, **Practicals:** 15
Maximum Marks: 50,

Objectives: This course aims at learning at Mathematical Typesetting with $LATEX$ so as to acquaint the students with tips and techniques for document processing.

Structure of the Course: This course is divided into three units of 15 lectures in total; tentatively 5 lectures are required for each unit wherein one lecture is of one hour duration.

Unit-I(5 Lecture)

Introduction to Latex: Benefits of LateX, open-source software, installing LateX, introduction to LateX packages, creating a document (Preamble-commands to create LateX file), adding basic information to a document, formatting words, lines, paragraphs, line spacing and changing styles, creating a two-column landscape document.

Unit-II(5 Lecture)

Mathematical typesetting with LateX: Accents and symbols, mathematical typesetting (elementary and advanced): use of braces, backslash, power, subscript, superscript, fractions, roots. ellipsis etc.

Unit-III(5 Lecture)

Mathematical Equations: Writing mathematical equations, mathematical symbols, multiline equations, inserting sections. subsections, pictures, enumerating the text, writing matrices. Introduction to Beamer presentations. Introduction to Overleaf (for creating LateX document online).

Practical: 01 Credit
Duration: 15 hours

Copmputer Laboratory Work:
At least 10 practicals from the entire syllabus: creating 05 LateX documents with different packages and styles. 03 practicals for preparing beamer presentation and 02 practicals on creating LateX document in Overleaf.

15.5.2023

Book Recommended

1. Stefan Kottwitz, *LateX: Beginner's Guide,* Packt Publishing, Brmingham, Mumbai, 2011.
2. Antoni Diller,*LATEX: Line by Line,* John Wiley and Sons, 1999.
3. Donald Bindner and Martin Erickson, *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics,* CRC Press, Taylor and Francis Group, LLC, 2011.
4. Leslie Lamport, *LaTeX: A Document Preparation System, User's Guide and Reference Manual,* Second Edition, Pearson Education. Indian Reprint, 1994.
5. M. Goossen, S. Rahtz and F. Mittebach, *The LATEX: Graphics Companion,* Adison Wesley, 1997.

Scheme of Examination: Internal Examination: To be conducted by the Course Coordinator.
(i) After covering half of the syllabus, there shall be a Mid Term Assessment Test of 90 minutes duration carrying 10 marks. The question paper must spread uniformly over half of the syllabus covered and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The Internal End Semester Examination of $2\frac{1}{2}$ hours duration carrying 15 marks, shall consist of two sections:

Section A. Four(3) short answer questions one question from each unit and each question shall carry 2 marks. All questions shall be compulsory.

Section B. Six(6) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which three(3) questions are to be answered selecting at least one question from each unit. Each question shall carry 3 marks.

Practical Examination
(i) Daily Evaluation of practicals/tutorials/viva-voce/records: 10 marks
(ii) Final Practical Examination: 15 marks.

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SEMESTER III
(Examination to be held in December 2023, 2024, 2025)
Ability Enhancement Course

Course Code: UAEMAT306
Course Title: Linear Programming
Credits: 03 **Total Number of Lectures: Theory: 45**
Maximum Marks: 75

Objectives: Besides finding the optimal solution, the amin objective of this course is using LPP to provide an information base for the most efficient allocation of scarce so as to optimize the allocation of some resources.

Structure of the Course: This course is divided into four units of 45 lectures in total; tentative number of lectures required for each unit is indicated against each unit, wherein one lecture is of one hour duration.

Unit-I (12 Lectures)

The Linear Programming Problems: Standard, Canonical and Matrix Forms, Decision Variables, Objective Function and Constraints, Solution of LP Problems by Graphical Method; Hyperplanes, Extreme Points, Convex and Polyhedral Sets. Examples and Exercises based on these concepts-to be done as tutorials.

Unit-II(11 Lectures)

Idea of Slack and Surplus Variables, Basic solutions: Basic Feasible Solutions; Reduction of any feasible solution to a basic feasible solution; Infeasible solution, unbounded solution, Non-degenerate basic feasible solution, Maximum Feasible Solution; Correspondence between basic feasible solutions and Extreme Points, Fundamental Theorem of Linear Programming. Examples and Exercises based on these concepts-to be done as tutorials.

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Unit-III (11 Lectures)

Simplex method: Optimal solution, Termination criteria for optimal solution of the Linear Programming Problem, Unique and Alternate Optimal Solutions, Unboundedness; Simplex Algorithm and its Tableau Format. Examples and Exercises based on these concepts-to be done as tutorials.

Unit-IV (11 Lectures)

Motivation and Formulation of Dual Problem. Dual Simplex Method, Applications of LP models to: Product-Mix Problems. Transportation Problem, Assignment Problem, Diet Problem. Examples and Exercises based on these concepts-to be done as tutorials.

Text Books:

1. G. Hadley, *Linear Programming,* Narosa Publishing House. 1997.
2. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali. *Linear Programming and Network Flows,* (4th Ed.), John Wiley and Sons, 2010.

Reference Books:

1. G. V. Shenoy, *Linear Programming, Methods and Applications,* Wiley Easter Ltd. 1992.
2. Steve Vajda, *Mathematical Programming.* Dover Publications Inc. 2009.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus, there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over uniformly on the first two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

Semester – IV(MATHEMATICS)

4 Credits Courses

S.No.	Course Type	Course No.	Course Title	Credits	Marks				Total Marks
					Theory: 75		Tutorial:25		100
1.	Major	UMJMAT401	Real Analysis-II	4	Mid Semester:	End Semester	Assessment	Exam	
2.	Major	UMJMAT402	Abstract Algebra-I	4					
3.	Major	UMJMAT403	Theory of Numbers	4	15 marks	60 marks	10 marks	15 marks	
4.	Major	UMJMAT405	Three Dimensional Solid Geometry	4					
5.	Minor	UMIMAT406	Abstract Algebra	4					

Head of the Department, 2023
P.G. Deptt. of Mathematics
University of Jammu
Jammu
Convener - BOS(Maths)

University of Jammu
Syllabus of Mathematics at FYUGP under CBCS as per NEP-2020.

SEMESTER IV
(Examination to be held in May 2024, 2025, 2026)
Major Course

Course Code: UMJMAT401
Course Title: Real Analysis-II
Credits: 04 Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: This course aims at advancing the course on Real Analysis-I (UMJMAT301) that includes uniform continuity, Riemann integral, uniform convergence of sequences and series of functions.

Prerequisite of this course: UMJMAT301

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

Cauchy's condensation test and convergence of alternating series, Absolute and conditional convergence, Leibnitz's test. Some theorems on continuity and uniform continuity viz. every continuous function attains its bounds on a closed and bounded interval, location of roots, Intermediate value theorem, continuity implies uniform continuity on closed and bounded intervals, relation between continuity and uniform continuity. Examples and exercises based on these concepts-to be done as tutorials.

Unit-II

The Riemann Integral: Definitions and existence of the integral, Refinement of a partition, Darboux's property, Conditions of integrability, the integral as a limit of sum, Integration and differentiation, The Fundamental Theorem of Calculus, Mean Value Theorems of Integral Calculus, Integration by parts. Change of variable in an integral, Second Mean Value Theorem. Examples and exercises based on these concepts-to be done as tutorials.

Unit-III

Point-wise and uniform convergence of a sequence and series of functions, Cauchy's criterion for uniform convergence. M_n-test for uniform convergence of a sequence, Weierstrass $M-$test for uniform convergence of a series, Abel's test. Examples and exercises based on these concepts-to be done as tutorials.

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Unit-IV

Properties of uniformly convergent sequences and series: Uniform convergence and continuity. Uniform convergence and Integration, Uniform convergence and differentiation. Examples and exercises based on these concepts-to be done as tutorials.

Text Books:

1. Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis*, Wiley India Edition, 2011.
2. Richard R. Goldberg. *Methods of Real Analysis*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Reference Books:

1. S.C. Malik and Savita Arora, *Mathematical Analysis*. New Age International Publisher, 1982 (2020 reprint).
2. Walter Rudin, *Principles of Mathematical Analysis*, 3rd Edition. McGraw-Hill International Editions, 1976.
3. Tom M. Apostol. *Mathematical Analysis*, Narosa Publishing House, 1985.
4. Charles G. Denlinger. *Elements of Real Analysis*, Jones and Bartlett India Pvt. Ltd, 2011.
5. Houshang H. Sohrab, *Basic Real Analysis*, Birkhauser, 2003.
6. H. Protter, *Basic Elements of Real Analysis*, Springer, 1998.
7. Stevan G. Krantz, *Real Analysis and Foundations*, CRC Press, 2000.
8. William R. Parzynski and Philip W. Zipse, *Introduction to Mathematical Analysis*, McGraw-Hill International Editions, 1987.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

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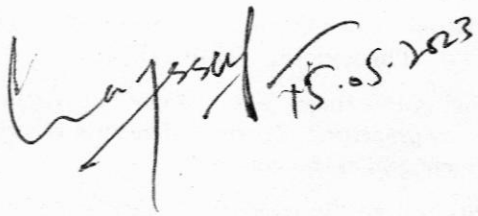
Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).



University of Jammu
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SEMESTER IV
(Examination to be held in May 2024, 2025, 2026)
Major Course

Course Code: UMJMAT402
Course Title: Abstract Algebra-I
Credits: 04 Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: The aim of this course is to introduce an algebraic structure called group and study its properties. Three fundamental theorems of group isomorphism is the ultimate goal of this course.

Prerequisite of this course: Knowledge of Higher Secondary level mathematics courses is enough to follow this course.

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

Review of Logic, Equivalence relation and Fundamental Theorem on equivalence relation. Binary operations, semi-group and group with plenty of examples from number systems, matrices, functions, polynomials, group of symmetries of triangle, square (Dihedral groups) etc. Abelian group, non-abelian group, finite group, order of an element of a group. Examples and exercises on these topics-to be done as tutorials.

Unit-II

Sub-groups and their characterisation, intersection, union and product of subgroups, subgroups generated by a subset, center of group, commutator subgroup of a group, characterisation of abelian group in terms of commutator subgroup. Examples and exercises on these topics-to be done as tutorials.

Unit-III

Permutations and their properties, Even and Odd permutations, Cyclic groups and their generators, properties of cyclic groups. Cosets: Left Cosets and Right Cosets and their properties, Lagrange's Theorem, Index of a subgroup, Euler's Theorem, Fermat Theorem. Examples and exercises on these topics-to be done as tutorials.

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Unit-IV

Normal subgroups and their properties, Group homomorphisms and their properties, Group isomorphisms and their properties. Quotient groups, Kernel of a group homomorphism. First, Second and Third Isomorphism Theorems for groups. Examples and exercises on these topics-to be done as tutorials.

Text Books:

1. Steve Warner, *Pure Mathematics for Beginners*, Get 800 LLC, 2018.
2. N.S Gopalakrishnan, *University Algebra*, New Age International Publishers, 2009.

Reference Books:

1. John B. Fraleigh, *A first Course in Algebra*, Narosa Publishing House, 2003.
2. I. N. Herstein, *Topics in Algebra*, John Wiley and Sons Inc., 2006.
3. Michael Artin, *Algebra*, Pearson New International Edition, 2013.
4. Thomas W. Hungerford, *Algebra*, Springer, 1974 (Seventh Indian Print, 2014).
5. D. A. R. Wallace, *Groups, Rings and Fields*, Springer, Second Indian Print, 2015.
6. Surjeet Singh and Qazi Zameeruddin, *Modern algebra*, Vikas Publishing House Pvt. Ltd., 1972.

Note to the College: Teaching and understanding of concepts of Mathematics being different from other disciplines requires problem solving sessions beyond regular class work. Therefore, extra three lectures per week need to be devoted to problem solving sessions as tutorials.

Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to

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be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

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University of Jammu
Syllabus of Mathematics at FYUGP under CBCS as per NEP-2020.

SEMESTER IV
(Examination to be held in May 2024, 2025, 2026)
Major Course

Course Code: UMJMAT403
Course Title: Theory of Numbers
Credits: 04 Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: The main objective of this course is to introduce an elementary theory of numbers.

Prerequisite of this course: Knowledge of Higher Secondary level mathematics 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

Divisibility: the division algorithms and its uniqueness, greatest common divisor, prime number, Euclid's first theorem, Fundamental Theorem of Arithmetic, standard form of an integer, divisior of n. Linear Diophantine Equation $ax + by = c$, necessary and sufficient condition for solvability of linear Diophantine equation, Radix representation, Euclid's second theorem, Infinitude of primes of the form $4n + 3$ and of the form $6n + 5$. Examples and exercises on these topics-to be done as tutorials.

Unit-II

Congurences and their properties, Complete residue system, reduced residue system. Multiplicative function, Euler's $\phi-$ function, Fermat's little theorem, Euler theorem. Generalization of Fermat's Theorem. Polynomial congurences, degree of polynomial congruence. Linear Congurence, solution of linear congruence. Chinese Remainder theorem. Wilson's theorem and its application to the solution of $x \equiv -1(modp)$. Examples and exercises based on these concepts-to be done as tutorials.

Unit-III

Integers belonging to a given exponent $modm$, Primitve roots, power residues, congruence of degree two. power modulus. Quadratic residue and quadratic non residue. Quadratic residue of m cannot be a primitive root of m. Quadratic residues of a odd prime are congruent to even powers of a primitive root of p and conversely, quadratic non residue of an odd prime are congruent to odd powers of a primmitive root of p and conversely, Euler criterion, Legendre symbols and their properties. lemma of Gauss. Quadratic Resciprocity law, Jacobi symbols. Examples and exercises based on these concepts-to be done as tutorials.

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Unit-IV

Greatest integer function, Number theoretic functions or Arithmetic functions, simple properties of $\phi(n)$, $\tau(n)$, $\sigma(n)$. Perfect number, divisors of n Mobius function, F. Martein's lemma, Mobius Inversion formulae. Theorem of Gauss. Examples and exercises based on these concepts-to be done as tutorials.

Text Books David M.Burton, *Elementary Number Theory*, Mc Graw-Hill Edition(India) Pvt. Ltd., 2013.

Reference Books:

1. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, *An Introduction to Theory of Numbers*, Wiley India Pvt. Lrd., 2008.
2. Tom M. Apostol, *Introduction to Analytic Number Theory*, Narosa Publishing House, 1991.
3. Ian Stewart and David Hall, *Algebraic Number Theory*. Chapman and Hall 1979.
4. Gareth A. Jones and J. Mary Jones, *Elementary Theory of Numbers*, Springer, 1998.
5. M. G. Nadkarni, *Number Theory*, Tata Mac. Graw Hill, 1988.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

(ii) The External End Semester Examination of 3 hours duration carrying 60 marks, shall consist of two sections:

Section A. Four(4) short answer questions one question from each unit and each question shall carry three(3) marks. All questions shall be compulsory.

Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials).

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University of Jammu
Syllabus of Mathematics at FYUGP under CBCS as per NEP-2020.

SEMESTER IV
(Examination to be held in May 2024, 2025, 2026)
Major Course

Course Code: UMJMAT404
Course Title: Three Dimensional Solid Geometry
Credits: 04 Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, **Theory:** 75, **Tutorial:** 25

Objectives: The aim of this course is to study the geometry of three dimensional solid figures like sphere, cone and cylinder.

Prerequisite of this course: Euclidean Geometry and elementary Vector 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

Equation of straight line, plane, and circle, Tangent Plane, Direction Cosines and ratios, relation between Direction ratios and direction cosiness. Angle between lines. planes and lines and plane, Intersection of planes and lines. Examples and exercises based upon these conceptsExamples and exercises based on these concepts-to be done as tutorials.

Unit-II

Definition of sphere and its formation. tangent plane to the sphere, General, Standard and Central form of equation of sphere, Equation of a sphere through four points. Intersection of a sphere and a line, Angle between two spheres, Orthogonal spheres. Examples and exercises based upon these conceptsExamples and exercises based on these concepts-to be done as tutorials.

Unit-III

Definition of Cone and its formation, tangent plane to the cone. Equation of Cone with a given vertex and guiding Curve, Equation of a cone with vertex at origin, General condition for a 2nd degree eqn. to represent a Cone, Intersection of two Cones with a Common vertex, Right Circular Cone. Examples and exercises based upon these conceptsExamples and exercises based on these concepts-to be done as tutorials.

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Unit-IV

Definition of Cylinder and its formation, tangent plane to the cylinder, Equation of cylinder whose generators intersect a given Conic, Enveloping cylinder of a sphere, Equation of right circular cylinder. Examples and exercises based upon these conceptsExamples and exercises based on these concepts-to be done as tutorials.

Text Book:

Shanti Narayan and P. K. Mittal, *Analytical Solid Geometry*, S. Chand and Co., 17th Edition, 2007.

Reference Books:

1. A. R. Vasishtha and D. C. Agarwal. *Analytical Solid Geometry*, Krishna Prakashan, 2019.
2. C. Godfrey and A. W. Siddons, *Solid Geometry*, Cambridge University Press, 2016.
3. William F. Osgood and William C. Graustein, *Plane and Solid Analytic Geometry*, New York Macmillan Company, 1921.

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Scheme of Examination: (i) After covering half of the syllabus (two units) there shall be a Mid Term Assessment Test of 90 minutes duration carrying 15 marks. The question paper must spread over entire two units and questions asked should be of short answer as well as long answer type. This test shall be conducted by the course coordinator.

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15.05.2023

University of Jammu
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SEMESTER IV
(Examination to be held in May 2024, 2025, 2026)
Minor Course

Course Code: UMIMAT405
Course Title: Abstract Algebra
Credits: 04 Total Number of Lectures: Theory: 45, Tutorials: 15
Maximum Marks: 100, Theory: 75, Tutorial: 25

Objectives: The aim of this course is to introduce an algebraic structure called group and study its properties. Three fundamental theorems of group isomorphism is the ultimate goal of this course.

Prerequisite of this course: Knowledge of Higher Secondary level mathematics courses is enough to follow this course.

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

Review of Logic, Equivalence relation and Fundamental Theorem on equivalence relation. Binary operations, semi-group and group with plenty of examples from number systems, matrices, functions, polynomials, group of symmetries of triangle, square (Dihedral groups) etc. Abelian group, non-abelian group, finite group, order of an element of a group. Examples and exercises based on these concepts-to be done as tutorials.

Unit-II

Sub-groups and their characterisation, intersection, union and product of subgroups, subgroups generated by a subset, center of group, commutator subgroup of a group, characterisation of abelian group in terms of commutator subgroup. Examples and exercises on these topics-to be done as tutorials.

Unit-III

Permutations and their properties, Even and Odd permutations, Cyclic groups and their generators, properties of cyclic groups. Cosets: Left Cosets and Right Cosets and their properties, Lagrange,s Theorem, Index of a subgroup. Euler,s Theorem, Fermat Theorem. Examples and exercises on these topics-to be done as tutorials.

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Unit-IV

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Section B. Eight(8) long answer questions spread uniformly over the entire syllabus (two questions from each unit) out of which four(4) questions are to be answered selecting at least one question from each unit. Each question shall carry 12 marks.

(iii) 25 marks are allotted to Tutorials out of which 10 marks are allotted to continuous assessment and 15 marks are for the final examination (on Tutorials)

15.05.2023