Darrang College (Autonomous), Tezpur-784001

Syllabus for FYUGP

Subject: Mathematics

Course Type: MAJOR

2025-2026

Approved by:

Board of Studies meeting held on 24-12-2025

&

Academic Council vide Resolution no. 2, dated- 29-12-2025

DARRANG COLLEGE (AUTONOMOUS)

TEZPUR ASSAM

FOUR YEAR UNDERGRADUATE PROGRAMME

SYLLABUS

DEPARTMENT OF MATHEMATICS

(As per NEP-2020)

Aims of Four Year Under Graduate Programme in Mathematics is to foster a comprehensive understanding and appreciation of Mathematics through innovative teaching, research and

application, equipping students with the skills to solve real world problems and advance in their academic and professional pursuits.

Program Outcome: The completion of the FYUGP shall enable a student to:

- Communicate mathematics effectively by oral, written, computational and graphic means
- Create mathematical ideas from basic axioms
- Gauge the hypothesis, theorems, techniques and proofs provisionally
- Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis and synthesis
- Identify applications of mathematics in other disciplines and in the real world, leading to enhancement of career prospects in a plethora of fields.
- Appreciate the requirement of lifelong learning through continued education and research.

Teaching learning process: The Department of Mathematics at Darrang College (Autonomous) is primarily responsible for organizing the Bachelor of Science/ Bachelor of Arts course with Major in Mathematics. Tutorial and practical related instructions are provided by the respective registering units under the general guidance of Department of Mathematics. There shall be 90 instructional days excluding examination in a semester.

Teaching learning tools: Teaching Learning Tools involves:

- Green-board teaching
- ICT tools- Projector, smart board etc.
- Course-based practical work using Desktop/Laptop computers.
- Along with these there are viva-voce, mock test, demonstration, presentation, classroom tests, and assignments.

The achievement of course is described in each course papers as learning outcomes in detail.

Evaluation/assessment:

The students registered for academic program will study Semester I to VIII at the Darrang College (Autonomous) and during these semesters Major, Minor and SEC courses are offered.

- English shall be the medium of instruction and examination for Major courses and English/Assamese for Minor courses.
- Examinations shall be conducted at the end of each Semester as per the Academic calendar notified by the Darrang College (Autonomous).
- The assessment broadly comprises of Internal Assessment (Sessional Examination, Assignments Presentation/Viva-Voce/Group Discussion, Attendance,) and End Semester Examination.
- Theory papers without practical/presentation consist of total 100 marks divided into 60 marks for theory, 40 marks for internal assessment.
- Theory papers with practical/presentation and Skill Enhancement Courses consists of total 100 marks divided into 60 marks for theory, 20 marks for internal assessment and 20 marks for Practical/Presentation.
- Internal assessment of 40 marks is comprises with 20 marks from sessional examination, 10 marks from assignment, 06marks for Presentation/Viva-Voce/Group Discussion and 4 marks from attendance (4 marks for above 75% attendance).
- Each practical paper will carry 30 marks including 25 marks for continuous evaluation and 2 marks for practical note book and 3 marks for the oral test or viva voce. Hardcopy of practical file has to be maintained by the students for each practical paper and has to be submitted in the concerned department at the time of examination
- Each presentation will carry 20 marks including 15 marks for continuous evaluation and 2 marks for presented report and 3 marks for the oral test or viva voce. The departments will decide the process of continuous evaluation for the task carried-out against the presentation. Hardcopy of the report has to be maintained by the students for each presented paper and has to be submitted in the concerned department at the time of examination.

Course Structure:

The program is a four year course divided into eight semesters. A student is required to complete 176 credits for the completion of course and the award of degree as Major student.

- 4 credit papers = 100 marks (60T+20IA+20P with practical)/ (60T+40IA without practical)
- Question pattern: ➢ For 100 marks papers (60T+40IA) [1 marks× 8 (no options), 2 marks × 6(10 options), 5 marks × 4 (8 options), 10 marks × 2 (5 options)]
- For 75 marks papers (45T+30P) [1 marks× 4 (no options), 2 marks × 3(no options), 5 marks × 3 (6 options), 10 marks × 2 (5options)]

CURRICULUM COMPONENTS

- **Distribution of Credits in first 3 years:**

Sl No.	**Type**	**Credit**
1	Major 15 x 4	60
2	Minor 06 x 4	24
3	SEC 3+3+3	09

- 1 CREDIT = 15 hours (one hour of classroom instruction per week)

*Skill-based courses may be worked out in line with the UGC guidelines under National Skill Qualification Framework (NSQF)/ National Credit Framework (NCrF)

- **B. A. / B.Sc Course distribution for first year**

Year	Semester	Course Code	Title of the course	Credit
1st Year	1st Semester	MAT-MJ-01014	Algebra	4
		MAT-MJ-01014	Algebra	4
		SEC01013 (Major oriented)*	MS Power Point and LaTeX	3
		VAC	--	2
		MDC	--	3
		AEC	--	4
	Total	**--**	**--**	**20**
	2nd Semester	MAT-MJ-02014	Calculus	4
		MAT-MJ-02014	Calculus	4
		SEC02013 (Major oriented)*	Programming in C	3
		VAC	--	2
		MDC	--	3
		AEC	--	4
	Total	**--**	**--**	**20**

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS
SEMESTER-I

Title of the course	**Algebra-I**
Course code	MAT-MJ-01014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment: 40)

Course Objectives: The primary objective of this course is to explain students about the general structure of equations, complex numbers, matrices, basic concepts of set theory. Furthermore, fundamental concepts of mathematical logic and reasoning will be taught to them.

Learning Outcome: This course will enable the students to:

- Employ De Moivre's Theorem in a number of applications to solve numerical problems.
- Determine the number of positive/negative real roots of a real polynomial using Descartes' rule of sign, also, learn about symmetric functions of the roots for cubic and biquadratic equations.
- Learn how to solve cubic equations.
- Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, also, finding inverse and rank of a matrix.
- Learn the basics of set theory including partial order relation, countability of sets.
- Learn how to deal with mathematical statements which are composite or with quantifiers, also, statements with implications.

Unit	Content	L	T	P	Total Hrs
I	**Complex Numbers and Theory of Equations:** **Complex Numbers**: Polar representation of complex numbers, De Moivre's Theorem (both integral and rational index) and its applications, Roots of a complex number, n^{th} roots of unity. **[1]** Chapter:2 (Sections 2.7-2.11) **(10 Marks)**	10	02	--	12

	Theory of Equations: Polynomial and Polynomial Equations, Deduction from Fundamental Theorem of Classical Algebra, Descartes' rule of signs, Relation between roots and coefficients of a polynomial equation of degree n, Symmetric functions of roots for cubic and biquadratic equations, Transformation of equations, Cardan's method of solution of a cubic equation. **[1]** Chapter: 5 (Sections: 5.1, 5.3.4, 5.4, 5.5, 5.6 upto 5.6.3, 5.11.2) **(15 Marks)**	12	02	--	14
II	**Matrices:** Elementary operations on a matrix, Matrix inversion and properties, Rank of a matrix, Determination of rank by reduction into echelon form, Symmetric matrix, Hermitian matrix, Elementary matrices and equivalence Consistency of linear systems, Solutions of system of homogeneous linear equations. **[2]** Chapter: 3 (Sections: 3.7), Chapter: 2 (Sections: 2.1 to 2.4) **(15 Marks)**	12	02	--	14
III	**Basics of set theory:** Partial order relation, poset, chain, upper and lower bounds in poset, greatest element and least elements, maximal and minimal elements, supremum and infimum, Zorn's Lemma, Finite and infinite sets, countable and uncountable sets. **[3]** Chapter:6 (Sections: 6.2, 6.3), Chapter: 7 (Sections: 7.1, 7.2) **(10 Marks)**	08	02	--	10
IV	**Mathematical Statement and Logic:** Mathematical statement, Statement with quantifiers "*there exists"* and *"for every*", Compound statement using *"or"* and *"and",* Statements with implications: *"if-then"* statement and *"if and only if"* statement, Contra-positive statement, The Induction Principle, **[3]** Chapter: 1(Sections: 1.1, 1.2 upto Exercise 1.2.13, 1.3 up-to Exercise 1.3.8, 1.4), Chapter: 5 (Section: 5.1) **(10 Marks)**	09	01	--	10

Text Books:

1. Mappa, S.K., (2011). *Higher Algebra (Classical)* (Revised 8th Edition), Levant Books.
2. Meyer, Carl .D., (2000). *Matrix Analysis and Applied Linear Algebra*, Society for Industrial and Applied Mathematics (Siam). https://vik.wiki/images/2/21/FmLinalg_jegyzet_2000_Meyer.pdf
3. Kumar, A., Kumaresan, S. and Sarma, B.K., (2018*). A Foundation Course in Mathematics*, Narosa.

Reference Books:

1. Andreescu, T. and Andrica, D., (2014). *Complex numbers from A to...Z.* (2nd Edition), Birkhäuser.
2. Dickson, Leonard E., (2009). *First Course in the Theory of Equations*, John Wiley & Sons, Inc. The Project Gutenberg, eBook: http://www.gutenberg.org/ebooks/29785.
3. Halmos, P. R., (2009). *I Set Theory*, Springer.
4. Andreescu, T. and Andrica, D., (2014). *Complex numbers from A to...Z.* (2nd Edition), Birkhäuser.
5. Dickson, Leonard E., (2009). *First Course in the Theory of Equations*, John Wiley & Sons, Inc. The Project Gutenberg, eBook: http://www.gutenberg.org/ebooks/29785.
6. Halmos, P. R., (2009). *Naive Set Theory*, Springer.

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-II

Title of the course	**Calculus**
Course code	MAT-MJ-02014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment: 40)

Course Objectives: The primary objective of this course is to develop a deep and rigorous understanding of real analysis including convergence and divergence of sequences and series of real numbers, also understand the quantitative change in the behavior of the variables and apply basic tools of calculus which are helpful in understanding their applications in many real world problems.

Learning Outcome: This course will enable the students to:

- Understand many properties of the real line R, including completeness and Archimedean properties.
- Learn to define sequences in terms of functions from N to a subset of R.
- Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
- Apply limit comparison tests for convergence of an infinite series of real numbers.
- Understand continuity and differentiability in terms of limits.
- Describe asymptotic behavior in terms of limits involving infinity.
- Compute the reduction formulae.
- Apply the concepts of asymptotes and inflexion point in tracing of curves.

UNIT	CONTENT	L	T	P	Total Hrs
I	**Basic concepts of real numbers:** Algebraic and order properties of R, absolute value and real line, bounded sets, supremum and infimum, completeness property of R, the Archimedean property, the density theorem. **[1]** Chapter:2 (Sections 2.1-2.4) **(10 Marks)**	09	01	--	10
II	**Sequence and Series:** Real sequences, limit of a sequence, convergent sequence, bounded sequence, Limit theorems, monotone sequences, Monotone convergence theorem, Subsequences and the Bolzano Weierstrass theorem, monotone subsequence theorem, Cauchy sequences, Cauchy's convergence criterion, properties of	13	02	--	15

	divergence sequences, Introduction to series. **[1]** Chapter:3 (Sections 3.1 to 3.7) **(15 Marks)**				
III	**Limits, Continuity and Differentiability :** Limit of a function, Continuity and types discontinuities. Differentiability of a function, Successive differentiation: Calculation of the nth derivatives, Leibnitz theorem, Partial differentiation, Euler's theorem on homogeneous functions, Infinite limits, Indeterminate forms. [**1]**Chapter 1, Chapter 3 (Sections 3.2, 3.3 and 3.6), and Exercise 26, page 184 **[2]** Chapter 10 **[4]** Chapter 12 (Section 12.3) and Chapter 2 (Section 2.5) **(15 Marks)**	13	02	--	15
IV	**Reduction formulae and Tracing of Curves:** Reduction formulae: Reduction formulae for and their applications. **[3]** Chapter 4 (Sections 4.1 – 4.6) (**10 Marks)**	09	01	--	10
	Tracing of Curves: Asymptotes, Concavity and inflexion points, Singular points, Tangents at the origin and nature of singular points, Curve tracing (cartesian and polar equations) **[4]** Chapter 9 (Sections 9.1, 9.2 and 9.9 (Polar curves only), Chapter 11 **(10 Marks)**	09	01	--	10

Text books:

1. Bartle, R. G. and Sherbert, D. R., (2002). *Introduction to Real Analysis* (3rd Edition), JohnWiley and Sons. https://sowndarmath.wordpress.com/wp-content/uploads/2017/10/real-analysis-by-bartle.pdf
2. Anton, H., Bivens, I. and Davis, S. F., (2013). *Calculus (*10th Edition). John Wiley & Sons Singapore Pte. Ltd. Reprint (2016) by Wiley India Pvt. Ltd. Delhi.

https://3lihandam69.wordpress.com/wp-content/uploads/2018/10/calculus-10th-edition-anton.pdf

3. Narayan, S. and Mittal, P.K., (2005). *Differential Calculus,* S. Chand.
4. Narayan, S. and Mittal, P.K., (2007). *Integral Calculus,* S. Chand.
5. Gorakh, P., (2016). Differential Calculus (19th Edition), Pothishala Pvt. Ltd. Allahabad.

Reference book:

1. Kumar, A. and Kumaresan, S., (2014). *Basic Course in Real Analysis*, CRC Press.
2. Thomas Jr,. G. B., Weir, M. D., and Hass, J., (2014). *Thomas' Calculus* (13th Edition), Pearson. https://rodrigopacios.github.io/mrpacios/download/Thomas_Calculus.pdf

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-III

Title of the course	**Ordinary Differential Equations**
Course code	MAT-MJ-03014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment: 40)

Course Objectives: The main objective of this course is to introduce the students to the exciting world of differential equations and their solutions methods.

Course Learning Outcomes: The course will enable the students to:

- Learn basics of 1st order ordinary differential equations and 2nd order linear differential Equations
- Learn different techniques for solving the differential equations

UNIT	CONTENT	L	T	P	Total Hrs
I	**First Order Ordinary Differential Equations**: Classification of differential equations; their origin and application. Solutions. First order exact differential equation. Integrating factors, Rules to find an integrating factor. **[1]** Chapter 1(Sections 1.1and 1.2) Chapter 2 (Sections 2.1, 2.2 and 2.4) Linear equations and Bernoulli equations. Basic theory of higher order linear differential equations. Solving differential equation by reducing its order. Wronskian and its properties. **[1]** Chapter 2 (Section 2.3), Chapter 4 (Sections 4.1 and 4.6) **(30 Marks)**	26	04	--	30
II	**Second Order Linear Differential Equations** : Linear homogenous equations with constant coefficients. Linear non- homogenous equations; the method of undetermined coefficients, the method of Variation of Parameters. The Cauchy-Euler equations. **[1]** Chapter 4 (Sections 4.2, 4.3, 4.4 and 4.5) (**30 Marks)**	26	04	--	30

Text Book:

[1] Ross, Shepley L. (1984). Differential Equations (3rd Ed.), John Wiley & Sons,Inc.

Reference Book:

1.Kreyszig, Erwin (2011). Advanced Engineering Mathematics(10th ed.).John Wiley & Sons, Inc. Wiley India Edition 2015.

Title of the course	**Abstract Algebra**
Course code	MAT-MJ-03024
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment: 40)

Course Objectives: The primary objective of this course is to introduce abstract mathematical objects, viz. groups, rings and fields and study their properties. It is also focussed to study the consequences of these mathematical structures.

Course Learning Outcomes: On successful completion of the course students will be able to:

- Recognize the mathematical objects called group, ring and fields.
- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Explain the significance of the notion of Permutation groups, cosets, cyclic groups, normal subgroups, factor groups.
- Analyze consequences of Lagrange's theorem and Fermat's Little theorem.
- Describe structure preserving mappings between groups and their consequences.
- Describe the fundamental concepts in ring theory such as of the subrings, integral domains, ideals, factor rings and fields.

UNIT	CONTENT	L	T	P	Total Hrs
I	Definition and examples of groups, Elementary properties of groups, Symmetries of a square, Dihedral groups, order of a group, Order of an element in a group, Subgroups, Subgroup Tests, Subgroup generated by an element of a group, Centre of a group, Centralizer of an element in a group, Cyclic groups, Properties of cyclic groups, Fundamental theorem of cyclic groups. **[1]** Chapter 1 to Chapter 4. **(15 Marks)**	13	02	--	15
II	Permutations, Permutation group, Properties of permutations, Even and odd permutations, Alternating groups, Cosets, Properties of cosets, Lagrange's Theorem, Fermat's Little Theorem,	13	02	--	15

	Normal subgroups, Factor groups. **[1]** Chapter 5 (up to theorem 5.7), Chapter 7 (up to theorem 7.2), Chapter 9 (up to theorem 9.2) **(15 Marks)**				
III	Isomorphism of groups, Cayley's Theorem, Properties of isomorphism, Group homomorphism, Kernal of a group homomorphism, Properties of group homomorphism, First isomorphism Theorem of groups. [1] Chapter 6 (up to theorem 6.3), Chapter 10 (up to theorem 10.4) **(15 Marks)**	13	02	--	15
IV	Rings, Examples of rings, Properties of rings, Subrings, Zero-Divisors in a ring, Integral domains, Fields, Characteristic of a ring, Ideals, Ideal Test, Factor rings, Prime ideals and maximal ideals of a ring. [1] Chapter 12 to Chapter 14. **(15 Marks)**	13	02	--	15

Text Books:

1. Gallian Joseph A., *Contemporary Abstract Algebra* (8th Edition) , Cengage Learning India Private limited, Delhi, Fourth impression, 2015.

Reference Books:

1. David S. Dummit and Richard M. Foote, *Abstract Algebra* (2nd Edition) , John Wiley and Sons (Asia) Pvt. Ltd. , Singapore, 2003.
2. John B. Fraleigh, *A First course in Abstract Algebra*, 7th Edition, Pearson, 2002.
3. G. Santhanam. *Algebra*, Narosa Publishing House, 2017.

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-IV

Title of the course	**Theory of Real Functions**
Course code	MAT-MJ-04014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment: 40)

Course Objective: The course will develop a deep and rigorous understanding of real line R and of defining terms to prove the results about convergence and divergence of series of real numbers. It is also focused to study limit point of set and limit of a function. The discussion on continuous functions and differentiability with some related theorems will also be focused in this course. These concepts have wide range of applications
in real life scenario.

Course Learning Out comes: This course will enable the students to:

- Apply limit comparison tests for convergence, the ratio, root, Raabe's, integral tests for convergence of an infinite series of real numbers.
- Alternating series and absolute convergence of an infinite series of real numbers.
- Have a rigorous understanding of the concept of limit of a function.
- Learn about continuity and uniform continuity of functions defined on intervals.
- Understand geometrical properties of continuous functions on closed and bounded intervals.

UNIT	CONTENT	L	T	P	Total Hrs
I	Infinite series, convergence and divergence of infinite series, Cauchy criterion, Tests for convergence: comparison test, limit comparison test, ratio test, root test, integral Test, Raabes's test, Absolute convergence, rearrangement theorem, alternating series, Leibniz test, conditional (non-absolute) convergence. **[1]** Chapter 3: Section: 3.7, Chapter 9: Sections: 9.1-9.3. **(25 Marks)**	22	03	--	25
II	Cluster point or limit point of a set, limits of a function ($\varepsilon - \delta$ approach), sequential criterion for limits, divergence criteria, limit theorems, one sided limits, infinite limits and limits at infinity. **[1]** Chapter 4 **(15 Marks)**	13	02	--	15

III	Continuous functions, sequential criterion for continuity and discontinuity, algebra of continuous functions, continuous functions on intervals, maximum-minimum theorem, intermediate value theorem, location of roots theorem, preservation of intervals theorem, uniform continuity, uniform continuity theorem, monotone and inverse functions. **[1]** Chapter 5 (5.1 to 5.6) **(20 Marks)**	17	03	--	20

Text Book:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons, 2002.

Title of the course	**Linear Algebra**
Course code	MAT-MJ-04024
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objectives: The objective of this course is to introduce the students with the fundamental theory of linear spaces and also emphasizes the application of techniques using the adjoint of linear operator and minimal solutions to systems of linear equations.

Course Learning Outcomes: This course will enable the students to:

- Learn about linear spaces and their general properties, linear dependence and linear independence of vectors, bases and dimensions of vector spaces
- Basic concepts of linear transformations, dimension theorem, matrix representations of linear transformations, and the change of coordinate matrix.
- Compute the characteristic polynomial, eigenvalues, eigenvectors and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result.
- Compute inner products and determine orthogonality on vector spaces including Gram-Schmidt orthogonalization to obtain orthonormal basis.

UNIT	CONTENT	L	T	P	Total Hrs

I	Definition and examples of vector spaces, general properties of vector spaces, Definition and examples of subspaces, subspace criterions and algebra of subspaces, null space and column space of a matrix, Linear transformations, Kernel and range of a linear transformation. **[1]:** Chapter 4 (Sections 4.1-4.2), **[2] :** Chapter 4 **(15 Marks)**	13	02	--	15
II	Linear combinations of vectors, linearly dependent and independent sets, bases of vector spaces, coordinate systems, dimension of a vector space, ranks, change of basis. **[1]:** Chapter 4 (Sections 4.3-4.7), **[2] :** Chapter 5 **(15 Marks)**	13	02	--	15
III	Eigenvectors and eigenvalues of a matrix, The Characteristic equation, Diagonalization, eigenvector of a linear transformation, Complex eigenvalues. Invariant subspaces and Cayley- Hamilton Theorem. **[1]:** Chapter 5 (Sections 5.1-5.5), **[2]:** Chapter 9, **[3]:** Chapter 5 (Sections 5.4) **(15 Marks)**	13	02	--	15
IV	Inner products, Length and orthogonality, orthogonal sets, orthogonal projections, The Gram- Schmidt process, Inner product spaces. **[1]:** Chapter 6 (Sections 6.1-6.4, 6.7), **[2]:** Chapter 12 **(15 Marks)**	13	02	--	15

Text Books:

1. David C. Lay, *Linear Algebra and its Applications*, 3rd Edition, Pearson Education, Asia, Indian Reprint, 2007

2. Seymour Lipschutz, *Theory and Problems of Linear Algebra*, Schaum's Outline Series, McGraw-Hill Book Company, Singapore

3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.

Reference Books:

1. S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India, 2017

2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007

3. G. Schay, Introduction to Linear Algebra, Narosa, 1997

Title of the course	**Analytical Geometry**
Course code	MAT-MJ-04034
Nature of Course	Major

Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objectives: The primary objective of this course is to introduce some basic tools of two dimensional and three-dimensional coordinate systems and also to familiarize the use of Vector Algebra in Coordinate Geometry.

Course Learning Outcomes: This course will enable the students to:

- transform coordinate systems
- learn about pair of straight lines
- have a clear understanding of the conic sections and related properties
- Recognize three dimensional surfaces represented by equations of the second degree
- learn two different systems of coordinates which are very useful to define the position of a point in space
- Acquire basic concepts of Vector Algebra and understand the use of geometric view of vectors in Coordinate Geometry.

UNIT	CONTENT	L	T	P	Total Hrs
I	Transformation of coordinates, invariants under orthogonal transformations, pair of straight lines. **[1]** Chapter 1 (Section 1.3), Chapter 2, Chapter 3 **(15 Marks)**	13	02	--	15
II	Parabola, parametric coordinates, tangent and normal, ellipse and its conjugate diameters with properties, hyperbola and its asymptotes, General conics: tangent, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standard forms, central conics, equation of the axes, and length of the axes, polar equation of a conic, tangent and normal, and properties. **[1]** Chapters 4, 5, 6, 7, 9 (upto Section 9.43) **(15 Marks)**	13	02	--	15
III	Quadric surfaces: Sphere, Cylinder and Cone. Cylindrical and spherical polar coordinates. **[1]** Chapter 6 (Section 6.1 – 6.3), Chapter 12 **(15 Marks)**	13	02	--	15
IV	Rectangular coordinates in 3-space, Vector viewed geometrically, Vectors in coordinates system, Vectors determined by length and angle, Dot product, Cross product and their geometrical properties, Triple	13	02	--	15

	product, Parametric equations of lines in 2-space and 3-space. **[2]** Chapter 11 (Section 11.1 - 11.5) **(15 Marks)**				

Text Books:

1. R.M. Khan, Analytical Geometry of two and three dimensions and Vector Analysis. New Central Book Agency, 2012.

2. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013), Calculus (10th ed.). John Wiley & Sons, Singapore Reprint (2016) by Wiley India Pvt. Ltd., Delhi.

Reference Book:

1. R.J.T. Bell, Coordinate Solid Geometry, Macmillan, 1983.

2. E.H. Askwith, The Analytical Geometry of the Conic Sections, Nabu Press (27 February 2012)

3. B. Das, Analytical Geometry and Vector Analysis, Orient Book Company, Kolkata -700007

Title of the course	**Number Theory-I**
Course code	MAT-MJ-04044
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objectives:

The primary objective of this course is to develop students' understanding of integers, with a focus on their properties and representations, as well as their understanding of number theoretic analysis.

Course Learning Outcomes: On successful completion of the course students will be able to:

• Explain division algorithm, Euclid's algorithms and greatest common divisor.
• Explain the concepts of congruences, linear congruences .
• Explore the Chinese Remainder theorem to solve simultaneous linear congruences.
• Explain Fermat's theorem and Wilson's theorem.
• Solve a range of problems in number theory
• Apply mathematical ideas and concepts within the context of number theory.
• Communicate number theoretic techniques to a mathematical audience.

UNIT	CONTENT	L	T	P	Total Hrs

I	Well-Ordering Principle of integers, Archimedian property, First principle of finite induction, Second principle of finite induction, The division algorithm of integers, The greatest common divisor, The Euclidean algorithm, The Diophantine equation , Fundamental Theorem of Arithmetic, The sieve of Eratosthenes, The Goldbach Conjecture. **[1]** Chapter 1 (Sections 1.1), Chapter2 (sections 2.2 -- 2.5), Chapter3. **(20 Marks)**	17	03	--	20
II	Congruence modulo of a fixed positive integer, Basic properties of congruences, Binary and decimal representation of integers, Linear congruences, Chinese Remainder Theorem, Fermat's Little Theorem, pseudoprimes, Wilson's Theorem. **[1]** Chapter 4 (Sections 4.2-4.4) Chapter5 (Sections: 5.2, 5.3). **(20 Marks)**	17	03	--	20
III	**:** Number Theoretic Functions: The sum and number of divisors of a positive integer, Multiplicative functions, Mobius function, The Mobius inversion Formula, The greatest integer function, Euler's Phi-Function, Euler's Theorem, Properties of Euler's Phi function. **[1]** Chapter 6 (Sections 6.1-6.3), Chapter 7 (Sections 7..2 to 7.4) . **(20 Marks)**	17	03	--	20

Text Books:

1. David M. Burton, *Elementary Number Theory*, 7th Edition, McGraw Hill Education (India) private limited. 2012.

Reference Books:

1. G.A. Jones and J. Mary Jones, *Elementary Number Theory*. Undergraduate Mathematics Series (SUMS) , 2005.

2. Neville Robinns, *Beginning Number Theory*. 2nd Ed., Narosa Publishing House Pvt. Ltd. Delhi- 2007

3. K.C. Chowdhury, *A First Course in Number Theory*, Asian Books Publications- 2012.

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-V

Title of the course	**Multivariate Calculus**
Course code	MAT-MJ-05014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objectives: To understand the extension of the studies of single variable differential and integral calculus to functions of two or more independent variables. Also, the emphasis will be on the use of Computer Algebra Systems by which these concepts may be analyzed and visualized to have a better understanding. This course will facilitate to become aware of applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

Course Learning Outcomes: This course will enable the students to:

- Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion.
- Understand the maximization and minimization of multivariable functions subject to the given constraints on variables.
- Learn about inter-relationship among the line integral, double and triple integral formulations.
- Familiarize with Green's, Stokes' and Gauss divergence theorems

UNIT	CONTENT	L	T	P	Total Hrs
I	Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Higher order partial derivative, Chain rule, Directional derivatives, The gradient, Maximal property of the gradient. **[1]** Chapter 11 [(Sections 11.1, 11.2, 11.3, 11.5, Section 11.6 (upto page 743)] **(15 Marks)**	13	02	--	15
II	Extrema of functions of two variables, Method of Lagrange multipliers,Constrained optimization problems; Definition of vector field, Divergence and curl. [1] Chapter 11 [Section 11.7 (up to page 754), Section 11.8 (pages 761-765)], Chapter13 (Section 13.1) **(15 Marks)**	13	02	--	15

III	Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals. **[1]** Chapter 12 (Sections 12.1-12.4) **(15 Marks)**	13	02	--	15
IV	Line integrals, Applications of line integrals**:** Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral; Surface integrals, Stokes' theorem, The Gauss divergence theorem. **[1]** Chapter 13 [(Sections 13.2, 13.3), Section 13.4 (pages 887-891), Section 13.5 (pages 898-901) Section 13.6 (pages 908-913), Section 13.7 (pages 916-919)] **(15 Marks)**	13	02	--	15

Text book:

[1] Strauss, Monty J.,Bradley, Gerald L.,& Smith, Karl J.(2012). *Calculus* (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011

Reference Books:

1. Marsden, J.E., Tromba, A., & Weinstein,A.(2004).*Basic Multivariable Calculus*. Springer (SIE). First Indian Reprint.

2. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.

3. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

Title of the course	**Real Analysis**
Course code	MAT-MJ-05024
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objective: The primary objective of this course is to study limit point of set and limit of a function. The discussion on continuous functions and differentiability with some related theorems will also be focused in this course.

Course Learning Outcomes: This course will enable the students to:

- Have a rigorous understanding of the concept of limit of a function.
- Learn about continuity and uniform continuity of functions defined on intervals.
- Understand geometrical properties of continuous functions on closed and bounded intervals.

- Learn extensively about the concept of differentiability using limits, leading to a better understanding for applications.
- Know about applications of mean value theorems and Taylor's theorem

UNIT	CONTENT	L	T	P	Total Hrs
I	Differentiability of a function at a point and in an interval, Caratheodory's theorem, chain rule, derivative of inverse function, Rolle's theorem, mean value theorem, Darboux's theorem, Cauchy mean value theorem, Taylor's theorem and applications to inequalities, Taylor's series expansions of exponential and trigonometric functions, ln(1+x), 1/(ax+b) and $(1+x)^n$. **[1]** Chapter 6, and Taylor series as in Section 6.4. **(25 Marks)**	22	03	--	25
II	Improper integrals and their convergence, various forms of comparison tests, absolute and conditional convergence, beta and gamma functions, Abel's and Dirichlet's tests. **[2]** Chapter 11 **(15 Marks)**	13	02	--	15
III	Propositional Calculus: operation on statements, truth function, laws of propositional logic, Boolean algebra of statement bundles, adequate system of connectives, binary connectives 'Nor' and 'and'. **[3]** Chapter 8: Section 8.1-8.5 **(10 Marks)**	08	02	--	10
IV	Boolean Algebra: disjunctive normal form (DNF), Complement of Boolean expression in DNF, construction of a Boolean function corresponding to a Boolean expression, conjunctive normal form (CNF), Complement of Boolean expression in CNF, transformation of normal form to the other form, applications. **[3]** Chapter 5: Section 5.1-5.5 **(10 Marks)**	08	02	--	10

Text Book:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons, 2002.

2. S.C. Malik and S. Arora, Mathematical analysis, New age international.

3. M. K. Sen, *Introduction to Discrete Mathematics,* Allied publisher.

Reference Books:

1. Ajit Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, Indian Ed. 2014.

2. K.A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2004.
3. C.L. Liu, Elements of discrete Mathematics, Mc Graw Hill, Comp.c. Series

Title of the course	**Numerical Analysis-I (with practical)**
Course code	MAT-MJ-05034
Nature of Course	Major
Total Credit	04 (Theory: 03 + Practical: 01)
Contact Hours	60
Total Marks	100 (End Term: 45, Practical:25, Internal Assessment:30)

Course Objectives: To comprehend various computational techniques to find approximate value for
possible root(s) of non-algebraic equations, to find the approximate solutions of system of linear equations and Quadratic equations.

Course Learning Outcomes: The course will enable the students to:

- Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and
  solution of a system of linear equations, up to a certain given level of precision.
- Know about iterative and non-iterative methods to solve system of linear equations
- Know interpolation techniques to compute the values for a tabulated function at points not in
  the table.
- Integrate a definite integral that cannot be done analytically
- Find numerical differentiation of functional values
- Solve differential equations that cannot be solved by analytical methods

UNIT	CONTENT	L	T	P	Total Hrs
I	Gaussian elimination method (with row pivoting), Gauss-Jordan method; Iterative methods**:**Jacobi method, Gauss-Seidel method; Interpolation**:** Lagrange form, Newton form, Finite differenceoperators, Gregory-Newton forward and backward difference interpolations, Piecewise polynomialinterpolation (Linear and Quadratic). **[1]** Chapter 3(Sections 3.1, and3.2),Chapter 6(Sections 6.1,and 6.2) Chapter 8(Section8.1, Section8.3 (8.3.1, and 8.3.2) **[2]** Chapter 3(Sections 3.2, and 3.4) Chapter 4(Section 4.2) Chapter 4(Sections 4.3,and 4.4)	17	03	--	20

	[1] Chapter 18 (Sections18.1to18.3) **(25 Marks)**				
II	Numerical differentiation**:** First and second order derivatives; Numerical integration**:** Trapezoid rule, Simpson's rule; Extrapolation methods**:** Richardson extrapolation, Romberg integration; Ordinary differential equation**:** Euler's method, Modified Euler's methods **(**Heun and Mid-point). **[2]** Chapter 11 [Sections 11.1(11.1.1,11.1.2,11.1.4), and11.2(11.2.1,11.2.2,11.2.4)] **[1]** Chapter 22 (Sections22.1, and 22.2,22.3) **(20 Marks)**	22	03	--	25
	Practicals: Use of computer aided software (CAS), for example *Matlab/Mathematica/Maple* etc., for developing the following numerical programs: (i) Lagrange's interpolation method (ii) Newton's interpolation method (iii) To calculate forward and backward differences (iv) Trapezoidal rule (v) Simpson's rule **(25 Marks)** **Note:** For any of the CAS *Matlab/Mathematica/Maple* etc., Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, arrays should be introduced to the students.	--	--	30	30

Text Books:

[1] Chapra, Steven C.(2018).*Applied Numerical Methods with* MATLAB *for Engineers and* Scientists
(4th ed.) Mc Graw-Hill Education.
[2] Fausett, Laurene V. (2009). *Applied Numerical Analysis Using* MATLAB. Pearson. India
[3] Jain, M.K., Iyengar, S.R.K., & Jain R.K.(2012). *Numerical Methods for Scientific and Engineering Computation* (6th ed.). New Age International Publishers. Delhi.

SEMESTER-VI

Title of the course	**Complex Analysis-I**
Course code	MAT-MJ-06014
Nature of Course	Major
Total Credit	04 (Theory: 03 + Practical: 01)
Contact Hours	60
Total Marks	100 (End Term: 45, Practical:25, Internal Assessment:30)

Course Objectives: The main objective of this course is to develop a deep understanding of the complex plane together with various related concepts. These concepts have wide applicability indifferent aspects.

Course Learning Outcomes: The completion of the course will enable the students to:

- Learn the significance of differentiability of complex functions leading to the understanding of Cauchy−Riemann equations.
- Learn some elementary functions and valuate the contour integrals.
- Understand the role of Cauchy-Goursat theorem and the Cauchy integral formula

UNIT	CONTENT	L	T	P	Total Hrs
I	Functions of complex variable, mappings, limits, theorems on limits, limits involving point at infinity, continuity. Derivatives, rules for differentiation, Cauchy-Riemann equations, sufficient conditions for differentiability, polar co-ordinates. **[1]:** Chapter 2 (Section 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24) **(15 Marks)**	08	02	--	10
II	Analytic functions, examples of analytic functions, harmonic function. The exponential function, Logarithmic function, examples, branches and derivatives of logarithms, some identities involving logarithms, the power function, trigonometric function, zeros and singularities of trigonometric functions derivatives of functions, definite integrals of functions. **[1]:** Chapter 2 (Sections 25, 26, 27), Chapter 3 (Sections 30, 31,32,33,34, 35, 36, 37, 38), Chapter 4(Section 41, 42) **(10 Marks)**	13	02	--	15

III	Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, antiderivatives, proof of antiderivative theorem. **[1]:** Chapter 4 (Section 43, 44, 45,47, 48, 49) **(10 Marks)**	08	02	--	10
IV	Cauchy-Goursat theorem, simply connected domains, multiply connected domains, Cauchy integral formula, extension of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra. **[1]:** Chapter 4 (Sections 50, 52, 53, 54, 55, 58) **(10 Marks)**	08	02	--	10
	PRACTICALS: (Modeling of the following problems using Matlab/ Mathematica/ Maple Etc.) 1. Declaring a complex number and graphical representation. e.g.Z_1 =3 + 4i, Z_2 = 4 – 7i 2. Program to discuss the algebra of complex numbers, e.g., Z_1 =3 + 4i, Z_2 = 4 – 7i, then find $Z_1 + Z_2$, $Z_1 – Z_2$, $Z_1 * Z_2$ and Z_1 / Z_2 3. To find conjugate, modulus and phase angle of an array of complex numbers: e.g. , Z = 2+ 3i, 4-2i, 6+11i, 2-5i 4. To compute the integral over a straight line path between the two specified end points. e. g., $\oint$ sin□ □, along the contour C which is a straight line path from -1+ i to 2 - i. 5. To perform contour integration., e.g., a) $\oint (z^2 – 2z + 1)dz$ along the Contour C given by $x = y^2 + 1; -2 \leq y \leq 2$. b) $\oint (z^3 + 2z^2 + 1)dz$ along the contour C given by $x^2 + y^2 = 1$, which can be parameterized by x = cos (t), y = sin (t) for $0 \leq y \leq 2\pi$. 6. To plot the complex functions and analyze the graph. e.g., f(z) = z, iz, z^2, z^3, e^z and $(z^4-1)/4$, etc **(25 Marks)**	--	--	30	30

Text Book:

1. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications (Ninth Edition), McGraw-Hill Indian Edition, 2021.

Reference Book:

1. Joseph Bak and Donald J. Newman, *Complex analysis* (2nd Edition), Undergraduate Texts in
2. Mathematics, Springer-Verlag New York, Inc., New York, 1997.
3. M.R. Spiegel, *Complex Variables*. Schaum's Outlines series, McGraw Hill Education, 2017

Title of the course	**Partial Differential Equations (with practical)**
Course code	MAT-MJ-06024
Nature of Course	Major
Total Credit	04 (Theory: 03 + Practical: 01)
Contact Hours	60
Total Marks	100 (End Term: 45, Practical:25, Internal Assessment:30)

Course Objectives: The main objectives of this course are to teach students to form and solve partial
differential equations and use them in solving some physical problems.

Course Learning Outcomes: The course will enable the students to:

- Formulate, classify and transform first order PDEs into canonical form.
- Learn about method of characteristics and separation of variables to solve first order PDE's.
- Classify and solve second order linear PDEs.
- Learn about Cauchy problem for second order PDE and homogeneous and non-homogeneous
  wave equations.
- Apply the method of separation of variables for solving many well-known second-order PDEs.

UNIT	CONTENT	L	T	P	Total Hrs
I	Introduction, Classification, Construction of first order partial differential equations (PDE). Cauchy's problem for first order equations, linear equations of the first order, Integral surfaces passing through a given curve, Nonlinear partial differential equations of the first order, Cauchy's method of characteristics, Charpit's method. Solutions satisfying given conditions, Jacobi's method. [1] Chapter 2 (Sections 2.1 to 2.3), [2] Chapter 2 (Section 3, 4,5, 7,8,10,12, 13) **(15 Marks)**	13	02	--	15
II	Canonical form of first order PDE, Method of separation of variables for first order PDE. [1] Chapter 2 (Sections 2.6 and 2.7) **(15 Marks)**	13	02	--	15

III	Reduction to canonical forms, Equations with constant coefficients, General solution. [1] Chapter 4 (Sections 4.1 to 4.5), [2] Chapter 3 (Sections 4, 5) **(15 Marks)**	13	02	--	15
	Practical /Lab work to be performed in a Computer Lab: Modelling of the following similar problems using Mathematica /MATLAB/ Maple/ Maxima/ Scilab etc. 1. Solution of Cauchy problem for first order PDE. 2. Plotting the characteristics for the first order PDE. 3. Plot the integral surfaces of a given first order PDE with initial data. 4. Solution of wave equation 5. Solving systems of ordinary differential equations 6. Solution of one-Dimensional heat equation **(25 Marks)**	--	--	30	30

(No. of practical classes: 30, Marks: 20)

Text Book:

1. Tyn Myint-U and Lokenath Debnath**,** *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.

2. Sneddon, I. N. (2006). *Elements of Partial Differential Equations*, Dover Publications. Indian Reprint.

Reference Book:

1. Stavroulakis, Ioannis P &Tersian, Stepan A. (2004). *Partial Differential Equations*: *An Introduction with Mathematica and* MAPLE (2nd ed.). World Scientific.

2. M. D. Raisinghania, Advanced Differential Equations, S. Chand & Company LTD.

Title of the course	**Metric Spaces**
Course code	MAT-MJ-06034
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objectives: Up to this stage, students do study the concepts of analysis which evidently rely on the notion of distance. In this course, the objective is to develop the usual idea of distance

into an abstract form on any set of objects, maintaining its inherent characteristics, and the resulting consequences.

Course Learning Outcomes: The course will enable the students to:

- Learn various natural and abstract formulations of distance on the sets of usual or unusuaentities. Become aware one such formulations leading to metric spaces.
- Analyse how a theory advances from a particular frame to a general frame.
- Appreciate the mathematical understanding of various geometrical concepts, viz. Balls or connected sets etc. in an abstract setting.
- Learn about the two important topological properties of metric spaces, namely connectedness and compactness.

UNIT	CONTENT	L	T	P	Total Hrs
I	Definition and examples of Metric spaces, sequences in metric spaces, Cauchy sequences, complete metric spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor's theorem. Subspaces, dense sets, separable spaces. [1] Chapter 1, Sections: 1.1-1.4, Chapter 2, Sections: 2.1, 2.2, 2.3.12 - 2.3.16 **(15 Marks)**	13	02	--	15
II	Continuity: Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Equivalent metrics, Isometry. Contraction mappings. [1] Chapter 3, Sections 3.1, 3.4, 3.5, 3.7 (upto 3.7.2) **(15 Marks)**	13	02	--	15
III	Connected metric spaces: Connectedness, connected subsets of real numbers, connectedness and continuous mappings, components. Compact metric spaces: bounded sets and compactness, other characterisations of compactness, continuous functions on compact spaces. [1] Chapter 4, Sections 4.1, Chapter 5, Sections 5.1, 5.2, 5.3 **(30 Marks)**	25	05	--	30

Text Book:

1. Satish Shirali & Harikishan L. Vasudeva, Metric Spaces, Springer Verlag London (2006) (First Indian Reprint2009)

Reference Books:

1. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
2. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.
3. Micheal O. Searcoid, Metric Spaces, Springer Publication, 2007

Title of the course	**Mechanics**
Course code	MAT-MJ-06044
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term: 60, Internal Assessment:40)

Course Objectives: The course aims at understanding the various concepts of physical quantities and the related motion of bodies under the action of forces.

Course Learning Outcomes: The course will enable the students to:

- Know about the concepts in statics such as moments, couples, equilibrium in both two and three dimensions.
- Understand the theory behind friction and center of gravity.
- Know about conservation of mechanical energy and work-energy equations.
- Learn about translational and rotational motion of rigid bodies.

UNIT	CONTENT	L	T	P	Total Hrs
I	Composition and resolution of forces, Parallelogram of forces, Triangle of forces, Converse of triangle of forces, Lami's Theorem, Parallel forces, Moment of a force about a point and an axis. Couple, Resultant of a system of forces. Equilibrium of coplanar forces. Friction, C.G of an arc, plane area, surface of revolution, solid of revolution. [3] Chapter I-X **(30 Marks)**	25	05	--	30
II	Velocities and acceleration along radial and transverse directions and along tangential and normal directions, motion in a straight line under variable acceleration, simple harmonic motion and elastic string. Newton's law of motion. Work, Energy and momentum, Conservative forces-Potential energy, Impulsive forces, Motion in resisting medium. [1] Chapter I Sections 1.1, 1.2,1.3, Chapter –2 Sections 2.1,2.2, Chapter 3 Sections 3.1.3.2, Chapter 4 Sections 4.1, Chapter 5Sections5.1,5.3,Chapter 6Sections6.1,6.3. [2] Chapter 3(Sections:3.1,3.2,3.3,3.4). **(30 Marks)**	25	05	--	30

Text Books:

1. S.L. Loney, An elementary treatise on the dynamics of a particle and of rigid bodies, Surjeet publications
2. F.Chorlton,TextbookofDynamics,CBS,Publications2ndEdition,1985
3. B.C. Das & B. N. Mukherjee, Statics, U. N. Dhur & Sons Pvt. Ltd.

Reference books:

1. M.R.Spiegel, Theoretical Mechanics, Schaum Series 2010.

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-VII

Title of the course	**Algebra-II**
Course code	MAT-MJ-07014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To enrich students with advanced knowledge and deeper understanding of algebra, enabling them to apply algebraic concepts effectively in higher studies and problem solving.

Course Learning Outcomes: On successful completion of the course students will be able to:

- Describe direct product of groups and different kinds of subnormal series of groups.
- Explain polynomial rings over commutative rings, PID, Euclidean Domain and UFD.
- Discuss field extension and its application to geometry.
- Identify about similarity of linear transforms and classify Jordan canonical forms and quadratic forms.

UNIT	CONTENT	L	T	P	Total Hrs
I	Direct product and Direct sums of Groups, Internal direct product and Decomposable Groups, Normal and Subnormal series of Groups, Solvable Groups, Composition series of Groups, Jordan-Holder theorem. [1] Chapter 4 (Section 1), Chapter 5. **(15 Marks)**	13	02	--	15
II	Polynomial rings over commutative rings, Divisibility in commutative rings, Principal Ideal Domain (PID), Euclidean Domain, Unique Factorization Domains (UFD) and their properties. Eisenstein's irreducibility criterion. [1] Chapter 9, Chapter 10. **(15 Marks)**	13	02	--	15

III	Subfields and Prime fields, Extensions of fields, Algebraic and Transcendental elements, Algebraic extensions, plitting fields, Perfect fields, Finite fields, Moore's theorem, Construction by ruler and compass. [1] Chapter 13, Chapter 14 (Section 4). **(15 Marks)**	13	02	--	15
IV	Canonical forms, Similarity of linear transforms, Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Primary decomposition theorem, Jordan blocks and Jordan canonical form, Quadratic forms, Reduction and classification of quadratic forms. [2] Chapter 6 . **(15 Marks)**	13	02	--	15

Text Books:

1. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House, 9th Revised Edition, 2006.
2. I. N. Herstein, Topics in Algebra, John Wiley & Sons, 2nd Edition, 1975.

Reference Books:

1. D. S. Malik, J. M. Mordeson and M. K. Sen, Fundamentals of Abstract Algebra, McGraw Hill Company, 1997.
2. C. Musili, Introduction to Rings and Modules, Narosa Publishing House, 1994.
3. K. Hoffman and R. Kunz, Linear Algebra, Prentice Hall, 1965.
4. K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India, 2004.
5. S. Lipschutz, Schaum's Outline Series of Linear Algebra, McGraw Hill, 2013.

Title of the course	**Real Analysis and Lebesgue Measure**
Course code	MAT-MJ-07024
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To provide a rigorous foundation of real analysis and to introduce the concepts of measure theory with emphasis on Lebesgue measure etc.

Course Learning Outcomes: On successful completion of the course students will be able to:

- Identify the region of convergence of power series.
- Illustrate Lebesgue measure on R, and construct integrals using Lebesgue measure.
- Explain basic convergence theorems for the Lebesgue integral.
- Explain sequences of functions and their uniform convergence
- CO5 Develop the core skills of the subject and research skills in this areas.

UNIT	CONTENT	L	T	P	Total Hrs
I	Pointwise and uniform convergence, Cauchy Criterion for Uniform Convergence, Interchange of Limits, Series of Functions, Tests for Uniform Convergence, Power series. **(15 Marks)**	13	02	--	15
II	Definition of the Riemann Integral, examples, Some Properties of the Integral, Riemann Integrable Functions, The Fundamental Theorem, The Darboux Integral, Definition of Riemann Steiltjes integral, examples and properties, Integration and Differentiation, Fundamental theorem of calculus. **(15 Marks)**	13	02	--	15
III	Set functions, Construction of Lebesgue measure, Measure spaces, Measurable functions, simple functions. **(15 Marks)**	13	02	--	15
IV	Lebesgue integration, Lebesgue's monotone convergence theorem, Fatou's theorem, Lebesgue's dominated convergence theorem, Comparison with Riemann integral, Integration of complex functions. **(15 Marks)**	13	02	--	15

Text Books:

1. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill Education, 1976
2. Bartle R.G. and Sherbert R.D., Introduction to Real Analysis, John Wiley & Sons, Inc

Reference Books:

1. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Private Limited, 2017
2. R.R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing, 2012.

Title of the course	**Complex Analysis-II**
Course code	MAT-MJ-07034
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To enhance students' understanding on complex analysis and equip learners with problem solving skill.

Course Learning Outcomes: This course will enable the students to:

- Define Conformal mappings and illustrate with examples.
- Discuss analytic continuation and Gamma function.
- Compute integrals of complex functions using Residue theorem.
- Understand the concept of Riemann surface.
- Formulate Power series expansions of complex valued functions.

UNIT	CONTENT	L	T	P	Total Hrs
I	**Power Series:**Taylor's and Laurent's Theorem, Zero and Singularity of an analytic function, The Argument Principle, Rouche's theorem. **(15 Marks)**	13	02	--	15
II	**Theory of Residues:**Residue, Calculation of Residues, Cauchy's residue theorem, Evaluation of definite integrals, Special theorems used in evaluating integrals, Mittag-Leffer's theorem. **(15 Marks)**	13	02	--	15
III	**Analytic functions as mappings:** Isogonal and Conformal Transformation, Necessary and sufficient condition of conformal transformation, Bilinear transformations, Geometrical inversion, Invariance of cross ratio, Fixed points of a bilinear transformation, some special bilinear transformation e.g. real axis on itself, unit circle on itself, real axis on unit circle etc. Branch point and Branch line, Concept of the Riemann surface. **(15 Marks)**	13	02	--	15
IV	**Analytic Continuation:**Analytical continuation, Schwarz's reflection principle, Infinite products, Gamma Function and its properties. **(15 Marks)**	13	02	--	15

Text Books:

1. M.R. Spiegel, Complex Variables. Schaum's Outlines series, McGraw Hill Education, 2017
2. E.G. Philips, Functions of acomplex variables with applications, Oliver and Boyd,1957.

Reference Books:

1. Walter Rudin, Real and Complex Analysis, McGraw Hill Education, 2017
2. L.V. Ahlfors, Complex Analysis, McGraw Hill, 2000
3. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press Oxford, 1990
4. Mark J. Ablowitz and A.S. Fokas, Complex Variables, Introduction and Application, CUP, 1998.
5. John B Conway, Functions of Complex Variable, Springer, 1872.

Title of the course	Differential Equations
Course code	MAT-MJ-07044
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To equip learners with analytical techniques and develop the ability to model physical, biological and engineering systems.

Course Learning Outcomes: Students will be able to:

- Identify critical point of an autonomous system and analyse their stability.
- Discuss Frobenius method of series solution for differential equations.
- Explain the existence and uniqueness of solution of first order differential equations
- Construct Green's function, and illustrate Sturm Liouville systems
- Explain the characteristics second order linear PDE.

UNIT	CONTENT	L	T	P	Total Hrs
I	Well posed problems, Existence, uniqueness and continuity of solution of ODEs of first order, Picard's method, Existence and uniqueness of solution of differential equations of first order, Sturm separation and comparison theorems, Homogeneous linear systems, Non-homogeneous linear systems. **(10 Marks)**	08	02	--	10
II	Linear homogeneous differential equation-Ordinary and singular points, Series solution, Method of Frobenius, Solutions of Bessel's and Legendre equations. **(10 Marks)**	08	02	--	10
III	Two point boundary value problems, Green's function, Construction of Green's function, Sturm Liouville systems, Eigen values and eigen functions, Stability of autonomous system of differential equations, Critical point of an autonomous system and their classification as stable, Asymptotically stable, Strictly stable and unstable, Stability of linear systems with constant coefficients, Linear plane autonomous systems, Perturbed systems, Method of Lyapunov for nonlinear systems. **(20 Marks)**	17	03	--	20
IV	Second order linear PDE-Classification, General solution of higher order PDE with constant coefficients, Method of Characteristics. **(20 Marks)**	17	03	--	20

Text Books:

1. S.L. Ross, Differential Equations, Second Edition, John Wiley & Sons, India, 2007.
2. I.N. Sneddon, Elements of Partial Differential Equations, Mcgraw Hill 2006
3. K.S. Rao, Introduction to partial differential equations, Prentice Hall, New Delhi, 1997.

Reference Books:

1. Lawrence C. Evans, Partial Differential Equations, Second Edition, American Mathematical Society, 2014.
2. Erich Zauderer, Partial Differential Equations of Applied Mathematics, A Wiley-Interscience Publication, John Wiley and Sons, 1983.
3. H.F. Weinberger, A first course in partial differential equations, Blaisdell, 1965.
4. C.R. Chester, Techniques in partial differential equations, McGraw Hill, New York, 1971.

5. R. Courant and D. Hilbert: Methods of Mathematical Physics: Partial differential equations, Vol –II, Wiley-VCH, 1989
6. W.E. Williams, Partial Differential Equations, Oxford University Press,1980
7. F.H. Miller, Partial Differential Equations, J. Wiley & Sons; London, Chapman & Hall, 1941.
8. A. Sommerfeld, Partial differential equations in physics, Academic Press, New York, 1967.
9. I. Stakgold, Green's functions and boundary value problems, Wiley, New York, 1979.

Title of the course	**Research Methodology**
Course code	MAT-MJ-07054
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To develop the ability to formulate research problems, design research studies and apply appropriate methods for data collection and analysis.

Course Learning Outcomes:

- Identify importance of hypothesis in different types of research.
- Classify the different types of research methods.
- Discuss the criteria of a good problem.
- Analyze and distinguish the interpretation of data
- Develop the idea of formulation of scientific articles, report writing and synopsis
- Explain the subject classification number and the preparation of bibliography.

UNIT	CONTENT	L	T	P	Total Hrs
I	**(a) Research-Introduction:** Knowledge and Research, Research and Scientific Thinking, Distinguishing characteristics of scientific thinking. Steps in the progress of scientific thinking. Characteristics of research. Classifications of research. Comparison of fundamental research and action research. **(b) Research Problem**: The source of problem. Criteria of a good problem. A guide to judge a research problem. Formulating and starting the problem. Definition of problem. Determination of the problem. Justification of the problem. **(10 Marks)**	08	02	--	10
II	**(a) Hypothesis:** The meaning of hypothesis. Importance of hypothesis, Source of hypothesis, Characteristics of hypothesis. The use of hypothesis in different types of research. Different forms of hypothesis. Difficulties in the formulation of hypothesis. Testing of hypothesis. **(b) Survey of related studies:** Purpose of survey of related studies, Research reading. The search of sources. Use of library, Note-taking. The bibliography.	08	02	--	10

	(10 Marks)				
III	Classification of Research Methods: Historical methods, normative survey method, Survey testing. The uestionnaire, Documentary frequency studies, Interview, Observation. Appraisal procedure, Experimental methods (Bases of experiential method, Variable control, Control of the experiment, purpose of control, methods of control, types of experiments, characteristics of an experiment, major steps in the experimental methods, experimental designs, limitations of experimental method). **(10 Marks)**	08	02	--	10
IV	**(a) Some tools and Techniques of Research:** Inquiry forms, Schedule, Opinionnaire, Sociometry, Social distance scale, Guess-who technique, Q-sort technique, Situational test, follow-up study, Quantitative studies, qualitative studies. **(b) Sampling:** The sampling theory, Bases of sampling, Importance of sampling. Advantage of sampling, Disadvantages of sampling, Characteristics of a good sampling. Steps in sampling procedure. Methods of sampling, Size of sampling. Errors in sampling. **(10 Marks)**	08	02	--	10
V	**Analysis and Interpretation of Data:** Analysis from the very beginning, Various steps in analysis and interpretation, Common statistical methods of analysis, Interpretation, Necessary precautions in interpretation, Comparison in interpretation, Conclusions and generalizations. **(10 Marks)**	08	02	--	10
VI	**The Research Report:** Preliminary Section, Main body of the report, Reference section, Style of writing, Tables, Figures, Quotations, Footnotes, Bibliography, Headings, Preparations of the report, Typing the report. Writing style of Synopsis. Strategy and steps for writing scientific articles. **(10 Marks)**	08	02	--	10

Text Books:

1. C.R. Kothari: Research Methodology, Methods and Techniques, 3rd Ed, New Age Publ. 2004
2. Antony Edward Kelly, Richard A. Lesh: Handbook of Research Design in Mathematics and Science Education, Lawrence Erlbaum Associates, Inc 2000
3. Michael P. Marder: Research Methods for Science, Cambridge University Press 2011

Reference Books

1. Steven J. Taylor, Robert Bogdan, Marjorie DeVault: Introduction to Qualitative Research Methods: A Guide Book and Resource, Wiley Publ. 2016
2. Nicolas J. Higham: Handbook of Writing for the Mathematical Sciences, Siam Pub. 1998
3. Margaret Cargill, Patrick O'Connor: Writing scientific articles: strategy and steps, Wiley-Blackwell 2013.

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-VIII (HONOURS)

Title of the course	**Topology**
Course code	MAT-MJ-08014
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To introduce students to the fundamental concepts of topological spaces, continuity, convergence and connectedness.

Course Learning Outcomes: The course will enable the students to:

- identify topological spaces and construct examples of such spaces.
- classify different spaces like first countable, second countable, separable spaces and give the characterization of these spaces using some important results like Urysohn's lemma, Tietze extension theorem.
- use the idea of compactness and connectedness and give their different characterizations.
- explain the product topology and its relationship with compactness, connectedness, and countability.
- provide examples of metrizable spaces and explain the relationship between embedding and metrization.

UNIT	CONTENT	L	T	P	Total Hrs
I	Definition and examples of topological spaces, Closed sets and closure, Dense subsets, Neighbourhood, Interior, Exterior and Boundary, Accumulation Points and Derived sets, Bases and subbases. Subbase and Relative Topology, Continuous Functions and Homeomorphism. **(10 Marks)**	09	02	--	11

II	Countable and uncountable sets, First and second Countable spaces, Lindelof's theorem, Separable spaces, Second Countability and Separability. **(10 Marks)**	04	01	--	05
III	Separation Axioms: T_0, T_1, T_2, $T_{3\frac{1}{2}}$, T_4 ; their characterizations and basic properties, Urysohn's lemma, Tietze Extension Theorem. **(10 Marks)**	08	02	--	10
IV	Compactness, continuous functions and compact sets. Basic properties of compactness and related theorems, Sequentially and Countably compact sets, Local Compactness and one point compactification, Stone-Cech Compactification. **(10 Marks)**	09	02	--	11
V	Connected spaces, connectedness on the real line, components, totally disconnected spaces, Locally connected spaces. **(10 Marks)**	09	02	--	11
VI	Tychonoff product topology in terms of standard subbase and its characterizations, Projection Maps, Separation Axioms and Product Spaces, Connectedness and Product spaces, Compactness and Product Spaces (Tychonoff's Theorem), Countability and Product Spaces, Embedding and Metrization, Urysohn's Metrization theorem. **(10 Marks)**	10	02	--	12

Text Books:

1. J. R. Munkres, Topology: A first course, Prentice Hall of India, 1974.
2. S. Willard, General Topology, Dover Publications, 2004.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India By PHI)

Reference Books:

1. K.D. Joshi, Introduction to General Topology, New Age International Private Limited, 2017
2. S. Lipschutz, Theory and Problems of General Topology, Schaum's Outline Series, McGraw-Hill Book Company, 1965.
3. M. G. Murdeshwar, General Topology, New Age International, 1990

Title of the course	**Number Theory-II**
Course code	MAT-MJ-08024
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To prepare learners for advanced mathematical studies and applications in crytography, coding theory and computational approaches.

Course Learning Outcomes: On successful completion of the course students will be able to:

- Describe primitive roots and indices for solvability of congruence of higher order.
- Explain the quadratic reciprocity law using Legendre's and Jacobi's symbol.
- Generate Fibonacci numbers and discuss related identities.
- Explain partition functions and develop graphical representations.

UNIT	CONTENT	L	T	P	Total Hrs
I	Primitive roots: order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, theory of indices. [1] Chapter 8 (Sections 8.1 to 8.4). **(15 Marks)**	13	02	--	15
II	Quadratic residues: Euler's criterion, Legendre's symbol and its properties, Quadratic Reciprocity Law, Quadratic congruences with compositemoduli. [1] Cha pter 9 (Sections 9.1 to 9.4). **(15 Marks)**	13	02	--	15
III	Fibonacci numbers: certain identities involving Fibonacci numbers, Continued fractions, Pell's equation. [1] Chapter 14 (Sections 14.1 to 14.3), Chapter 15 (Sections 15.2, 15.3 and 15.5). **(15 Marks)**	13	02	--	15
IV	Partitions, Graphical representation of partitions. Euler's partition theorem, Searching for partition identities, Partition generating functions. [2] Chapter 12 (Sections 12-1 to 12-4) Chapter 13(Section 13-1). **(15 Marks)**	13	02	--	15

Text Books:

1. David M. Burton, Elementary Number Theory, McGraw Hill Education, Seventh Edition, 2011.
2. G. E. Andrews, Number Theory, Dover Publications, 2012.

Reference Books:

1. I. Niven, H. S. Zuckerman and H. L. Montgomery, Introduction to Theory of Numbers, Wiley, 2008.

Title of the course	**Mechanics and Tensor Calculus**
Course code	MAT-MJ-08034
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To provide a fundamental understanding of classical mechanics and introduce the concept of tensors.

Course Learning Outcomes: Students will be able to:

- Explain various physical laws of motion, Hamiltonian's principle etc. with mathematical tools.

- Distinguish Tensors and perform algebraic operations on tensors, to obtain covariant derivatives of various tensors and to express Laplacian in tensor form.
- Apply various tools of vector algebra as well as vector calculus, calculus of variations to discuss the motion of rigid bodies under certain constraints.
- Differentiate the properties of motion in various coordinate systems viz. cylindrical, spherical, conical surfaces.
- Construct mathematical models viz. rigid body to describe motions under certain constraints or no constraints which are able to analyse the physical scenario.

UNIT	CONTENT	L	T	P	Total Hrs
GROUP-A: Mechanics					
I	Central forces, Central orbit, Laws of inverse square, Kepler's laws of planetary motion; Velocity and acceleration in cylindrical and spherical polar coordinates. Motion of a rigid body about a fixed point: Euler's equations, Motion under no external forces. **(15 Marks)**	13	02	--	15
II	Generalized coordinates: Lagrange's equations of motion for finite forces in holonomic systems, Case of conservative forces and theory of small oscillations. Hamilton's equations of motion, Variational methods, Hamilton's principle and Principle of least action. **(15 Marks)**	13	02	--	15
GROUP-B: Tensor Calculus					
III	Transformation laws of covariant and contravariant tensors, Mixed tensor, Rank of tensors. Kronecker delta. Algebraic operations on tensors: addition, subtraction, contraction, inner and outer product of tensors, Quotient law, Group property of tensors, symmetric and anti-symmetric tensors. Related theorems. Riemannian metric and Fundamental tensors. Christoffel symbols of the first and second kinds and their properties. Transformation laws of Christoffel symbols. **(15 Marks)**	13	02	--	15
IV	Covariant derivatives of tensors A_i, A^i, A_{ij}, A^{ij} and A^i_j, Generalizations. Covariant derivatives of fundamental tensors and scalar invariant function. Gradient of an invariant function. Divergence and curl of vectors. Laplacian in tensor form. Application in problems. **(15 Marks)**	13	02	--	15

Text Books:

1. S L Loney, An Elementary Treatise on the Dynamics of a Particle and Rigid Bodies, Cambridge University Press, 2017
2. Murray Spiegel, Theory & Problems of Theoretical Mechanics (Schaum's Outline Series), McGraw Hill Education, 2017
3. C. E. Weatherburn, An Introduction to Riemannian Geometry and the Tensor Calculus, Cambridge University Press, Paperback, 2008

Reference Books:

1. F. Chorlton, Text Books of Dynamics, John Wiley & Sons, 1983
2. B. C. Kalita, Tensor Calculus and Applications: Simplified Tools and Techniques, CRC Press, Taylor &Francis Group, 2019
3. David C. Kay, Tensor Calculus (Schaum's Outline Series), McGraw Hill Education, 2011
4. L. P. Eisenhart, Riemannian Geometry, Princeton University Press, 1997.

Title of the course	**Mathematical Methods**
Course code	MAT-MJ-08044
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

Course Objectives: To enhance analytical thinking and computational skills through applicationals of mathematical methods to real world models.

Course Learning Outcomes: Students will be able to:

- identify Fredholm integral equations and Volterra integral equations.
- apply Fourier transform to solve ordinary and partial differential equations of initial and boundary value problems.
- apply Laplace transform to solve ordinary, partial differential equations of initial and boundary value problems, and to evaluate definite integrals.
- use calculus of variations to extremize a functional with fixed boundaries.
- formulate and solve isoperimetric problems.

UNIT	CONTENT	L	T	P	Total Hrs
I	**Integral Equations:** Definition of Integral Equation, Reduction of ordinary differential equations into integral equations. Fredholm integral equations with separable kernels, Eigen values and Eigen functions, Method of successive approximation, Iterative scheme for Fredholm Integral equations of second kind. Volterra Integral Equations of second kind, Resolvent kernal of Volterra equation and its results, Application of iterative scheme to Volterra equation of the second kind, Convolution type kernals. **(15 Marks)**	13	02	--	15
II	**Fourier Transform:** Fourier Integral Transform. Properties of Fourier Transform, Fourier sine and cosine transforms, Application of Fourier transform to ordinary and partial differential equations of initial and boundary value problems. Evaluation of definite integrals. **(15 Marks)**	13	02	--	15

III	**Laplace Transform:** Basic properties of Laplace Transform, Convolution theorem and properties of convolution, Inverse Laplace Transform. Application of Laplace Transform to solution of ordinary and partial differential equations of initial and boundary value problems. The inversion theorem, Evaluation of inverse transforms by residue method. **(15 Marks)**	13	02	--	15
IV	**Calculus of variations:** Calculus of variation with one independent variable: Basic ideas of calculus of variations, Euler's equation with fixed boundary of the functional Containing only the first order derivative of the only dependent variable with respect to one independent variable, Variational problems with functional having higher order derivatives of the only dependent variable, general case of Euler's equation, applications. Calculus of Variation with several independent variables: Variational problems with functional dependent on functions of several independent variables having first order derivatives. Variational problems in parametric form, Variational problems with subsidiary condition: Isoperimetric problems. **(15 Marks)**	13	02	--	15

Text Books:

1. M. D. Raisinghania, Integral Equation & Boundary Value Problem, S. Chand, 2010.
2. Murray Spiegel, Schaum's Outline of Fourier Analysis with Applications to Boundary Value Problems , McGraw-Hill Education, 1974
3. M. R. Spiegel, Schaum's Outline Series: Theory and Problems of Laplace Transforms, McGraw- Hill Book Company, 1965.
4. I.M Gelfand and S.V. Fomin: Calculus of Variations, Prentice Hall, INC, 1963, Edited by R.A. Silvarman

Title of the course	**SEMINAR/ PROJECT**
Course code	MAT-MJ-08054
Nature of Course	Major
Total Credit	04 (Theory: 04 + Practical: 00)
Contact Hours	60
Total Marks	100 (End Term:60, Internal Assessment:40)

FOUR YEAR UNDERGRADUATE PROGRAMME IN MATHEMATICS

SEMESTER-VIII (HONOURS AND RESEARCH)

MAT0800116: Dissertation
Total Marks: 400
No. of Credits: 16

MAT0800204: SEMINAR
Total Marks: 100
No. of Credits: 4