Maharaja Surajmal Brij University

Bharatpur (Rajasthan)

Syllabus for Mathematics

(Under Graduate Programme)

Faculty of Science

Semester V&VI

Academic Session 2025-26

डॉ. अरूण कुमार पाण्डेय
उपकुलसचिव
प्रभारी अकादमिक प्रथम

Examination 2025-26 onwards

SEMESTER-WISE PAPER TITLES WITH DETAILS								
Three/Four Year Bachelor of Science (Maths Group)								
				Mathematics	Credits			
	Level	Sem	Type	Title	L	T	P	Total
1	5	I	MJR	MAT-20T-101 Discrete Mathematics and Differential Calculus	5	0	0	5
2	5	I	MJR	MAT-20P-102 MATH-Lab-I	0	0	1	1
3	5	II	MJR	MAT-20T-201 Integral Calculus, Geometry and Calculus	5	0	0	5
4	5	II	MJR	MAT-20P-202 MATH-Lab-II	0	0	1	1
5	6	III	MJR	MAT-20T-301 Real Analysis and Differential Equations	5	0	0	5
6	6	III	MJR	MAT-20P-302 MATH-Lab-III	0	0	1	1
7	6	IV	MJR	MAT-20T-401 Numerical Analysis and Linear Programming Problem	5	0	0	5
8	6	IV	MJR	MAT-20P-402 MATH-Lab-IV	0	0	1	1
9	7	V	MJR	MAT-20T-501 Modern Algebra and Matrices	5	0	0	5
10	7	V	MJR	MAT-20P-502 MATH-Lab-V	0	0	1	1
11	7	VI	MJR	MAT-20T-601 Complex Analysis and Mechanics	5	0	0	5
12	7	VI	MJR	MAT-20P-602 MATH-Lab-VI	0	0	1	1

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Content

1. Eligibility

As per the rules formed/framed by the Commissionerate Higher Education Rajasthan, Jaipur.

2. Scheme of Examination

(i) As per University notifications issued time to time.

(ii) 1 credit = 25 marks for examinations/evaluation. Each course in Semester Grade Point Average (SGPA) has two components-

(1) Continuous Assignment(CA). (20% weightage)

(2) End of the Semester Examination (EoSE) (80% weightage)

(iii) **Continuous Assessment (CA):**

Continuous Assessment constituting 20% of the total weightage, based on internal evaluations (Midterm test and Internal Assessment) conducted throughout the semester. The internal assessment component will comprise of assessment of students' performance on the basis of factors like Attendance, Classroom participation, Presentation, Home Assignment/ Project,etc.

(iv) **End of Semester Examination (EOSE):**

Each Paper of EoSE shall carry 80% of the total marks of the course/subject. The EoSE will be of 3 hours duration. There shall be five questions in each question paper of EOSE. There shall be two parts in each question paper viz. Part 'A' and Part 'B'. Part 'A' contains 8 very short answer type questions of 2 marks each covering the syllabus (all four units).

Part 'B' of the question paper shall contain four questions by taking one question from each unit. Each question of Part 'B' will have three subparts. Candidates are required to attempt all four questions of Part 'B' by taking any two subparts of each question. All questions carry equal marks (16 Marks of each question). Candidates are required to attempt all five questions.

(v) 75% Attendance is mandatory for appearing in EOSE.

(vi) To appear in the EoSE examination of a course/subject student must appear in the Practical examination and obtain at least a "C" grade in the course/subject.

(vii) Credit points in a course/Subject will be assign only if, the student obtains at least a C grade in Practical and EoSE examination of the course/subject.

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(3) Exit and Entrance Policy: -

1. Students who opt to exit after completion of the first year and have secured 48 credits will be awarded a UG Certificate if, in addition, they complete one internship of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
2. Students who opt to exit after completion of the second year and have secured 96 credits will be awarded

   the UG diploma if, in addition, they complete one internship of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.
3. Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 150 credits and satisfying the minimum credit requirement.
4. A four-year UG Honours degree in the major discipline will be awarded to those who complete a four- year degree programme with 200 credits and have satisfied the minimum credit requirements.
5. Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation Render the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 200 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

(4) Letter Grades and Grade Points-

Letter Grade	Grade Point	Marks Range (%)
O(Outstanding)	10	91-100
A+ (Excellent)	9	81-90
A (Very Good)	8	71-80
B+ (Good)	7	61-70
B (Above Average)	6	51-60
C (Average)	5	40-50
P (Pass)	4	
F (Fail)	0	
Ab (Absent)	0	

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Syllabus - Three/Four Year Undergraduate Programme in Science
(Maths Group)
V-Semester (Mathematics)

Type	Paper Code and Nomenclature	Duration of Examination	Maximum Marks (MT+ EoSE)	Minimum Passing Marks (MT+ EoSE)
Theory	MAT-20T-501 Modern Algebra and Matrices	1 Hrs- MT 3Hrs- EoSE	25 Marks- MT 100 Marks- EoSE	10 Marks- MT 40 Marks- EoSE
Practical	MAT-20P-502 MATH-Lab-I	1 Hrs- MT 2Hrs- EoSE	05 Marks- MT 20 Marks- EoSE	2 Marks- MT 08 Marks- EoSE

MAT-20T-501 Modern Algebra and Matrices

Semester	Code of the course	Title of the course/paper	NHEQF Level	Credit
V	MAT-20T-501	Modern Algebra and Matrices	5	5
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture (6 hrs a week), Seventy five lecture, including diagnostic and formative assessment during lecture hours.		
Prerequisites	Mathematics course of XIIth std. of Central Board of Secondary Education, Rajasthan board of secondary education or equivalent.			
Objectives of the courses	The main aim of the course is to introduce you to basic concepts from Modern algebra, especially the notion of a group. The Abstract Algebra module focuses on the power of abstraction by developing mathematical theories from axioms in several contexts – Group Theory, Rings and Fields. This course introduces the basic concepts of Ideals, Quotient ring and Vector Space. In this course student will also learn about the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.			

Course learning outcomes:

The student will be able to learn after completion of the course:

1. Develop a solid theoretical foundation in algebraic structures including groups, rings, integral domains and fields.
2. Apply theoretical concepts to solve problems involving group theory, ring theory.
3. Analyze and differentiate algebraic structures and their interrelations.
4. Understand the applications of algebraic structures in various mathematical and scientific disciplines.
5. learn to compute eigenvalues and eigenvectors of matrices, a critical concept in many engineering and scientific applications.

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6. gain the ability to compile and interpret matrix properties, such as rank, to analyze data and understand underlying structures in various applications.
7. use matrices to solve systems of linear equations and understand the relationship between matrix rank and the existence of solutions.

Syllabus

Teaching: 6 hrs per week

The Question paper will be divided into two parts, Part-A and Part-B

Part-A: Part-A contains one compulsory question consisting of 10 short answer type questions, each carrying 2 Marks. These 10 short questions are selected from all the units at least two questions from each unit. The Part-A of the question paper evaluate the candidate's knowledge, understanding, and application of the topics/texts covered in the syllabus.

Part-B: Part-B comprise four questions with one question from each unit, each carrying 20 marks. Each question in Part-B has four subparts. The candidate must attempt all four units by selecting any two subparts from each question. Each subpart within a question carries equal marks.

Note- The question Paper will be set in both Hindi and English.

Unit-I:

Definition and simple properties of Groups and subgroups. Integer equivalence classes and symmetries, Residue classes of set of integers, order of the element of a group, Algebra of complexes of a Group, Normalizer of an element, Centralizer, Centre of a group, Cyclic group, Multiplicative group of complex numbers, Theorems related to subgroups and cyclic groups, Lagrange's theorem and its consequences, Fermat's and Euler`s theorem, Order of the product of two subgroups of finite order, Permutations, Groups of permutations, Cyclic permutation, Even and odd permutation, alternating group, Theorems related to permutation.

(19 Lectures)

Unit-II :

Group Homomorphism, Kernel of a homeomorphism, Properties of homeomorphism, Cayley's theorem. Normal subgroup and its properties, Simple group, Quotient groups, Fundamental theorems of homomorphism. Definition and simple properties of Rings. and Sub-rings. Characteristic of Ring, Integral Domain and Field. Subring, Subfield and Prime field with examples, Morphism of Ring, Embedding of Ring and Integral Domain. Field of Quotient of an Integral Domain, Theorems on Prime fields.

(19 Lectures)

Unit-III:

Ideals and their properties, Maximal Ideal, Principal Ideal and Principal Ideal domain, Prime Ideal, Maximal Ideal, Quotient ring, Fundamental theorems of Ring homomorphism. Definitions, Examples and Simple properties of Vector spaces and Subspaces. Linear combination, Linear dependence and Linear independence of vectors. Basis and Dimension, Generation of subspaces. Sum of subspaces. Direct sum and Complement of subspaces, Quotient space and its dimension. Theorems related to basis and dimension.

(19 Lectures)

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Unit-IV:

Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Application of matrices to solve system of linear homogeneous equations. Characteristic Equation, Eigen values and eigen vectors of a matrix, Cayley Hamilton Theorem and its use in finding inverse of a matrix, Diagonalization of square matrices with distinct eigen values, Quadratic forms

(18 Lectures)

Text Books:

1. Gallian J. A., 1999, *Contemporary Abstract Algebra*, Narosa Publication House, New Delhi.
2. Bhattacharya P. B., Jain S. K. and Nagpal S. R., *Basic Abstract Algebra* (2nd Ed.), Cambridge University Press.
3. Gallian J. A., 1999, *Contemporary Abstract Algebra*, Narosa Publication House, New Delhi.
4. I.N. Herstein, Topics in Algebra (2nd edition), John Wiley & Sons.
5. J.K. Goyal and K.P.Gupta, Advanced Course in Modern Algebra, Pragati Prakashan,Meerut.
6. A.R Vasistha, Modern Algebra, Krishna Prakashan Media (P) Ltd Meerut.

Reference Books:

1. N. S. Gopalkrishnan, University Algebra, New Age International, 1986.
2. Qazi Zameeruddin and Surjeet Singh, Modern Algebra, Vikas Publishing, 2006
3. Fraleigh, J. B.: A First Course in Abstract Algebra, Narosa Publishing House, New Delhi.
4. Frank Ayres, Jr., Theory and problems in Abstract Algebra(2nd Ed.), Tata McGraw-Hill Pub. Co. Ltd., 2004.

MAT-20P-502 - MATH-Lab-I

Semester	Code of the course	Title of the course/paper	NHEQF Level	Credit
V	MAT-20P-502	MATH-Lab-V	5	1
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture and laboratory (2 hrs a week), thirty lecture including diagnostic and formative assessment during lecture hours.		
Prerequisites	The student must know the basic knowledge of Matrix Algebra.			
Objectives of the courses	In this course student will learn about the matrix and applications to solve the matrix equation AX = b using row operations and matrix operations. They will also learn about the characteristic equation, eigenvalues, and corresponding eigenvectors of a given matrix.			

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Course learning outcomes:

The student will be able to learn after completion of the course:

1. use matrices to solve systems of linear equations and understand the relationship between matrix rank and the existence of solutions.
2. **Identify the properties of similar matrices**, such as having the same determinant, trace, characteristic polynomial, eigenvalues, and rank.
3. **Apply similarity concepts** to simplify matrix operations and understand that similar matrices represent the same linear transformation with respect to different bases.
4. **Apply the diagonalization process** to find the invertible matrix
5. **Recognize that unitary similarity is a stronger condition** than general similarity and preserves the geometric properties of a matrix, as it corresponds to a change of orthonormal basis.

Syllabus

Teaching: 2 hrs per week

Practical – *Each candidate is required to appear in the practical examination to be conducted by internal and external examiners. External examiner will be appointed by university and internal examiner will be appointed by the principal consultation with Head, department of Mathematics in the college. An internal/External examiner can conduct practical examination of not more than 100 candidate (20 candidate in each batch).*

Distribution of Marks:

S.No.	Exercise	Marks
1.	Two Exercises one from each group	6+6=12
2.	Practical record	4
3.	Viva-Voce	4
4.	**Total**	**20 Marks**

Group-A: System of Non- homogeneous Linear Equations:- Consistency and Inconsistency, Condition of consistency, Condition for Uniqueness, Algorithm to find out Solution of AX=B.

(15 Lectures)

Group-B: Similarity of Matrices:- Similarity of Matrices, Diagonalizable Matrix, Diagonalization theorem, Computation of Power of Similar Matrix., Unitary Similar Matrices, Unitarily Reduction of Hermitian Matrices, Normal Matrices.

(15 Lectures)

Suggested Books and References –

1. Jr. Frank Ayres, Schaum's outline of theory and problems of matrices,TMH
2. A.R. Vasistha, Matrices, Krishna Prakashan, Meerut

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Syllabus - Three/Four Year Undergraduate Programme in Science
(Maths Group)
VI-Semester (Mathematics)

Type	Paper Code and Nomenclature	Duration of Examination	Maximum Marks (MT+ EoSE)	Minimum Passing Marks (MT+ EoSE)
Theory	MAT-20T-601 Complex Analysis and Mechanics	1 Hrs- MT/ 3Hrs- EoSE	25 Marks- MT 100 Marks- EoSE	10 Marks- MT 40 Marks- EoSE
Practical	MAT-20P-602 MATH-Lab-II	1 Hrs- MT 2Hrs- EoSE	05 Marks- MT 20 Marks- EoSE	2 Marks- MT 08 Marks- EoSE

MAT-20T-601 Complex Analysis and Mechanics

Semester	Code of the course	Title of the course/paper	NHEQF Level	Credit
VI	MAT-20T-601	Complex Analysis and Mechanics	5	5
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture(6 hrs a week),, Seventy five lecture including diagnostic and formative assessment during lecture hours.		
Prerequisites	The student must know the basic knowledge of complex variables, real analysis and Mechanics.			
Objectives of the courses	This course aims to introduce the basic ideas of analysis for complex functions in complex variables. Particular emphasis has been laid on Analytic Function, Conformal Mapping, Bilinear Transformation ,Complex Integration, Power series, singularities, various theorems and their applications. This course also helps the students to develop skills and knowledge of standard concepts in mechanics and to become aware of their applications. The course aims at understanding the various concepts of Kinematics, SHM, Projectile motion and Moment of Inertia.			

Course learning outcomes:

The student will be able to learn after completion of the course:

1. Grasped the concepts of Taylor's and Laurent's theorems as they apply to complex functions.
2. Conducted analysis on the singularities of analytic functions, including branch points, meromorphic functions, entire functions, and residues at singularities using the Cauchy residue theorem.

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3. Understand and calculate velocity and acceleration in various directions and analyze motion in resisting media.
4. Analyze the equilibrium of coplanar forces, calculate moments, and understand the effects of friction.
5. Apply the principles of virtual work to mechanical systems and analyze motion on smooth curves in vertical planes.
6. Mathematical treatment to the configuration called Catenary.

MAT-20T-601-Complex Analysis and Mechanics

Teaching: 6 hrs per week

The Question paper will be divided into two parts, Part-A and Part-B

***Part-A**: Part-A contains one compulsory question consisting of 10 short answer type questions, each carrying 2 Marks. These 10 short questions are selected from all the units at least two questions from each unit. The Part-A of the question paper evaluate the candidate's knowledge, understanding, and application of the topics/texts covered in the syllabus.*

***Part-B**: Part-B comprise four questions with one question from each unit, each carrying 20 marks. Each question in Part-B has four subparts. The candidate must attempt all four units by selecting any two subparts from each question. Each subpart within a question carries equal marks.*

***Note**- The question Paper will be set in both Hindi and English.*

Unit I:

Graphical representation of Complex numbers, Straight lines, and circles in terms of complex numbers, Stereographic projection, Inverse points with respect to a circle, Connected and Compact sets, Curves and Regions in complex plane. Jordan arc, Jordan Curve Theorem (statement only), Complex valued function-Limits, Continuity and Differentiability, Analytic functions, Cauchy-Riemann equations (Cartesian and polar form), Harmonic functions, Construction of an analytic function. Problems related to Analyticity of functions and Construction of an analytic function. Complex integration, Complex line integrals, Cauchy`s theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions

(19 Lectures)

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Unit II:

Cauchy integral formula and its generalized forms, Analyticity of the derivative of an analytic function, Morera's theorem, Cauchy's inequality, Poisson integral formula, Liouville`s theorem, Taylor's theorem. Laurent's theorem and its uniqueness, Maximal modulus theorem, Minium modulus theorem, Schwarz`s lemma, Singularities of an analytic function, Kinds of singularities, Branch point, Meromorphic and Entire functions, Riemann's theorem, Casorati-Weierstrass theorem, Zeros of an analytic function, Residue at a singularity, Cauchy's residue theorem, Zeros and Poles of Meromorphic function, Argument Principle. Rouche's theorem, Fundamental theorem of Algebra, Computation of Residues at finite pole and at infinity, evaluation of real definite integrals by contour integration

(19 Lectures)

Unit-III:

Velocity and Acceleration(Radial, Transverse, Tangential, Normal and Angular) Rectilinear Motion:- Simple Harmonic Motion, Hooke's law, Horizontal Elastic String, Vertical Elastic String, Repulsion from a fixed point, Motion under Inverse Square Law. Motion in Resisting Medium :- Resistance varies as velocity and square of velocity. Constrained Motion:- Motion on a smooth curve in a vertical plane, motion on inside and outside of a smooth circle. Moment of Inertia:- M. I of rod. circular ring, circular disk, rectangular, elliptical and triangular lamina, solid and hollow spheres, solid ellipsoid, Product of Inertia, Theorem of Parallel Axis.

(19 Lectures)

Unit-IV:

Equilibrium of a body under Coplanar Forces:- Reduction of System of Coplanar Forces into a Force and a Couple, Equilibrium of body Under Three Forces and more than Three Forces. Friction: Force of Friction, Angle of Friction, Coefficient of Friction, Cone of Friction, Limiting Equilibrium: on an Inclined Plane, Least Force Required to pull a Body up and down on an inclined rough plane. Catenary:- Equation of Common Catenary, Properties of Catenary, Sag of Tightly Stretched Wire. Virtual Work:- Principle of Virtual Work, Tension in a String, thrust in a Rod, Problems involving Elastic String and Curves, Problems Related to a body or a Frame work resting on a Pegs or on Inclined Plane.

(18 Lectures)

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MAT-20P-602-Paper - MATH-Lab-VI

Teaching: 2 hrs per week

Practical – Each candidate is required to appear in the practical examination to be conducted by internal and external examiners. External examiner will be appointed by university and internal examiner will be appointed by the principal consultation with Head, department of Mathematics in the college. An internal/External examiner can conduct practical examination of not more than 100 candidate (20 candidate in each batch).

Semester	Code of the course	Title of the course/paper	NHEQF Level	Credit
V	MAT-20P-602	MATH-Lab-VI	5	1
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	UG	Lecture and laboratory(2 hrs a week), thirty lecture including diagnostic and formative assessment during lecture hours.		
Prerequisites	The student must know the basic knowledge of complex variables, real analysis and Mechanics.			
Objectives of the courses	This course aims to introduce the basic ideas of analysis for complex functions in complex variables. This course also helps the students to develop skills and knowledge of standard concepts in mechanics and to become aware of their applications.			

Course learning outcomes:

The student will be able to learn after completion of the course:

1. Apply conformal mapping techniques to solve problems in physics and engineering, such as potential flow, electrostatics, and heat conduction, by transforming complex geometries into simpler ones.
2. Understand that conformal mappings preserve the angle and shape of infinitesimal figures but not necessarily their size.
3. Explain the concepts of rotation and scaling and how they relate to the derivative of the analytic function.
4. **Analyze Projectile Motion:** Decompose initial velocity into horizontal and vertical components and use kinematic equations to determine the trajectory, time of flight, and range of a projectile on a horizontal plane.
5. **Solve Problems on Inclined Planes:** Apply the principles of projectile motion to scenarios involving an inclined plane, including calculating the time of flight and range of a projectile launched up or down a slope.
6. **Predict Trajectories:** Calculate the specific initial velocity and angle of projection required for a projectile to pass through a given point in space
7. Use the differential equation of a central orbit to predict the shape of the orbit (e.g., circle, ellipse, parabola, or hyperbola) based on the particle's energy and angular momentum.

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Distribution of Marks:

S.No.	Exercise	Marks
1.	Two Exercises one from each group	6+6=12
2.	Practical record	4
3.	Viva-Voce	4
4.	**Total**	**20 Marks**

Group-A: Conformal Mapping- Necessary and sufficient conditions for w = f(z) to a conformal mapping, Graphical representation of conformal mapping. Bilinear transformation:- Basics of Bilinear Transformations and Graphical Representation of Elementary mapping. Analytic continuation- Power series method of analytic continuation.

(15 Lectures)

Group-B: Uniplanar Motion:- Projectile on a Horizontal Plane, Projection to pass through a given point, Projectile on an inclined Plane. Central Orbits- p-r equation, Apses, time in an orbit, Keplar's law of planetary motion.

(15 Lectures)

Each candidate (regular/non-collegiate) must prepare his/her record.

Text Books:

1. Brown JW, Churchill RV. Complex variables and applications. McGraw-Hill,; 2009.
2. M. Ray, A Text Book of Dynamics, S. Chand & Co., 2003.
3. J. K. Goyal and K. P. Gupta, Functions of a Complex Variable, Pragati Prakashan,Meerut.
4. P. P. Gupta and R. K. Gupta, Complex Variable, Kedar Nath Ram Nath, Meerut
5. M.R. Spiegel, Schaum`s outlines of Complex Variables (2nd Edition). TMH
6. G. N. Purohit and S. P. Goyal, Complex Analysis, Jaipur Publishing House, Jaipur.

Reference Books:

1. Kasana HS. Complex variables: theory and applications. PHI Learning Pvt. Ltd.; 2005.
2. Ponnusamy S, Silverman H. Complex variables with applications. Springer Science & Business Media; 2007.
3. A.S.Ramsey, Statics, CBS Publishing & Distributors, New Delhi.
4. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
5. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

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