UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Mathematics
Faculty of Science

M.Sc. (Mathematics)

First Semester Examination,
December 2025

Second Semester
Examination, June 2026

UNIVERSITY OF KOTA
MBS Marg, Near Kabir Circle, KOTA
(Rajasthan)-324 005
INDIA

Edition: 2025

M.A./ M.Sc. MATHEMATICS EXAMINATION – 2025-26

1. The Ordinances Governing the examination in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce, Management, Engineering, Education and Law are contained in separate booklet. The students are advised to refer to the same.

2. Changes in Statutes/ Ordinances/ Rules/ Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.

   Note: The decision taken by the Academic Council shall be final.

Programme Educational Objectives (PEOs)

By the end of the M.Sc. Mathematics program, students will be able to:

PEO1. Acquire a strong foundation in pure and applied mathematics with the knowledge, skills, and analytical ability to contribute as competent scientific manpower.

PEO2. Demonstrate advanced mathematical reasoning and problem-solving skills applicable to academia, industry, and interdisciplinary research.

PEO3. Apply mathematical tools, models, and modern computational techniques to solve real-world problems and contribute to technological advancement.

PEO4. Exhibit professional competence through teamwork, ethical practices, and a commitment to societal needs and sustainable development.

PEO5. Engage in lifelong learning, research, and innovation in mathematics and allied fields to remain current with evolving scientific trends.

Programme Outcomes (POs)

Upon successful completion of the program, the student will be able to:

PO1. Demonstrate mastery of advanced mathematical concepts, reasoning, and abstract thinking. (L2–L5)

PO2. Apply mathematics to model, analyze, and solve problems in science, engineering, and technology. (L3–L6)

PO3. Integrate knowledge from various branches of mathematics to pursue research or careers in industry and academia. (L4–L6)

PO4. Analyze problems critically, formulate hypotheses, validate results, and draw logical conclusions using quantitative and qualitative approaches. (L4–L5)

PO5. Communicate mathematical concepts effectively in oral and written form, using modern tools where appropriate. (L2–L6)

PO6. Display critical thinking and objectivity in scientific investigations, free from preconceived biases. (L4–L5)

Programme Specific Outcomes (PSOs)

PSO1. Understand fundamental axioms of mathematics and develop original ideas based on them. (L1–L6)

PSO2. Apply mathematical concepts and computational tools to research, industry, and interdisciplinary fields such as engineering and data science. (L3–L6)
PSO3. Demonstrate advanced knowledge in pure mathematics (e.g., algebraic topology, representation theory, number theory) with applications in cryptography, theoretical physics, and emerging technologies. (L2–L6)
PSO4. Solve complex mathematical problems using analytical reasoning, creative thinking, and modern computational software, including open-source tools. (L3–L6)
PSO5. Prepare effectively for competitive examinations (e.g., NET, GATE) and advanced research degrees through structured guidance and self-learning. (L1–L6)
PSO6. Exhibit professional responsibility, ethical practices, and a commitment to contribute to open-source mathematical software development. (L3–L6)

Duration of the Course

There shall be four semesters in two consecutive academic years and two semesters in each academic year (or as per the Rajasthan Government Directions wherever applicable)

Admission Criteria

Fresh Admissions – Semester – I

A candidate who has passed any one of the following examinations with Mathematics as a major subject from any University recognized by the UGC shall be permitted to take admission:

a. B.Sc. or B.A. with Mathematics as a main subject of study.
b. Three / Four-year B.Sc. (Hons.) with Mathematics
c. Bachelor of Science and Education (B.Sc.-B.Ed.) with Mathematics as a main subject.

Minimum qualifying marks to apply for the admission in M.Sc. Mathematics

A. Qualifying examination passed from any recognised University which is situated in Rajasthan State:

General Category = 55%.

SC / ST / OBC / SBC or MBC = Min. Pass Marks

B. Qualifying examination passed from any recognized University which is situated at outsidethe Rajasthan State:

All Categories = 60%.

Promotion – Semester – III

1. A candidate may be promoted in the next academic session (odd semester i.e. III semester) if he/she has cleared separately at least 50% of the papers of each semester (semester I & II) of previous academic session with 36% of the aggregate marks.
2. The candidate who does not fulfil the above condition will remain as an ex-student and will reappear in the previous semesters (semester I & II) examinations.
3. A candidate who has passed B.Ed. examination as a regular course of study after completing first and second semester examinations from this University shall also be eligible to take admission in third semester succeeding to B.ed. examination session.

Program Structure

The M.Sc. (Mathematics) programme with a credit weightage of 100 credit points, consists of:

1. Core and applied courses of theory papers which are compulsory for all students, which consist of 24 credit points for each semester I and II.
2. In semester III and IV one paper in each semester is compulsory while the candidate may opt for 3 papers from a group of available optional papers.
3. In IV semester the Prior requirement to opt 4O1, 4O2, 4O3, 4O4 and 4O5 are 3O1, 3O2, 3O3, 3O4 and 3O5respectively.
4. In IV semester an optional Dissertation/Project Work will be taken under the guidance of the teaching faculty available in the department/ affiliated college. This consist of 6 credit point of the required 24 credit points for IV semester.
5. Any of the optional courses/activities from following list# will be opted and accordingly completed by the candidate to get remaining 4 credit point to complete the full 100 credit points required to get the degree M.Sc. in Mathematics.

List of Interdisciplinary Courses/ Activities (4 Credits)

To get 4 credit points the candidate needs to engage with the following activities for at least 50 hours. The Course completion certificate, report with geo-tagged photographs, certificate from the organisations the candidate worked with will be submitted to the department/college and will be dully evaluated, only after successful evaluation the credit points would be awarded to the candidate.

1. Courses from UGC-SWAYM (Course Completion Certificate)
2. Courses from MOOC (Course Completion Certificate)

3. Courses from in.coursera.org (Course Completion Certificate)
4. Any other course from the sites like Linkedin* etc. which provide a certificate with clear mention of the course hours.
5. Any relevant theory course from interdisciplinary department available with the institution.
6. Extension Activities# – Community Services** (50 Hours) (Report with geo-tag photographs along with the Certificate by the organisation)
7. Significant contribution toward any research project (Data Collection, Data Analysis, Programming for computation) (Certificate from Principal Investigator/ Mentor/ Student Project with a clear mention of working hours)

#The extension activities do not include activities as NSS, Scout or NCC volunteer.
*The candidate is free to choose the course and site whether paid or free, however a completion certificate with a clear mention of hours attendance will be mandatory.
**Community Services would include – working for cleanliness drives, education specially to deprived children or adolescents, working for skill enhancement of deprived groups specially women, adolescents and children, conservation of natural flora and fauna, conservation of any endangered art or craft or any other activity allotted to the candidate by the organisation he/ she would be working with. This list is suggestive only and not to be considered as complete and final.

Note: All of the above activities must commence and complete within the period of the study of degree i.e. time period between the admission in Semester I to commencement of the examination for Semester IV, which should not ; in any condition be more then 2 years.

Course Code and Nomenclature

Paper Code will stand as MATH for mathematics, 1/2/3/4 for semester number, C or O for compulsory/ optional and (1/2/3…) for paper number.

Semester I			
S.No.	**Code**	**Name of the Paper**	**Credits**
1	MATH 1C1	ALGEBRA I	6
2	MATH 1C2	ANALYSIS I	6
3	MATH 1C3	MECHANICS	6
4	MATH 1C4	METHODS OF APPLIED MATHS I	6
Semester II			
1	MATH 2C1	NUMERICAL ANALYSIS	6
2	MATH 2C2	ANALYSIS II	6
3	MATH 2C3	PARTIAL DIFFERENTIAL EQUATIONS	6
4	MATH 2C4	METHODS OF APPLIED MATHEMATICS - II	6

University of Kota, Kota
M.Sc. Mathematics: Semester-wise Scheme of Examinations

Year /Semester	Nomenclature of Paper		Duration of Exam	Teaching Hours/ Week	Credit Points	Distribution of Marks				Total Marks	
						Internal Assessment		Final Assessment		Total Marks	
	Paper Code/ ID	Nomenclature of Paper				Max Marks	Passing Marks	Max Marks	Passing Marks	Max Marks	Passing Marks
Semester I	MATH 1C1	ALGEBRA I	3	6	6	50	20	100	40	150	60
	MATH 1C2	COMPLEX ANALYSIS OR ANALYSIS I	3	6	6	50	20	100	40	150	60
	MATH 1C3	MECHANICS	3	6	6	50	20	100	40	150	60
	MATH 1C4	METHODS OF APPLIED MATHS I	3	6	6	50	20	100	40	150	60
TOTAL OF I SEMESTER				**24**	**24**	**200**	**-**	**400**		**600**	
Semester II	MATH 2C1	NUMERICAL ANALYSIS	3	6	6	50	20	100	40	150	60
	MATH 2C2	ANALYSIS II	3	6	6	50	20	100	40	150	60
	MATH 2C3	PARTIAL DIFFERENTIAL EQUATIONS	3	6	6	50	20	100	40	150	60
	MATH 2C4	METHODS OF APPLIED MATHEMATICS - II	3	6	6	50	20	100	40	150	60

Teaching Methodology

The classroom teaching would be through conventional lectures or power point presentations (PPT).The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted, and group discussions would be arranged to improve theircommunicative skills.

The teaching methods would encourage use of technology as computing with some basic programming languages and software like C, C++, R Statistics, Python, MS Excel etc. the list is notconcluding.

Assessment Scheme

There shall be 4 Papers in each of the four semesters. Each paper has Max. 150 marks, 50 marks for Internal assessment and 100 marks for Main semester Examination of 3 hours duration. The Internal assessment consist of CIE (Term Test, Seminar, Assignments etc.) Minimum Pass Marks for Internal

Assessment shall be 20 and for Semester Examination 40 for each paper.

A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be charged from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after depositing the defaulter/ improvement fee. A record of such candidates shall be kept in the Department.

Question Paper Pattern & Distribution of marks:

Max. Marks: – 150 Internal assessment-50 Theory paper - 100

Duration: - 3 Hrs.

The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

Section-A: One compulsory question with 20 parts, having 4 questions from each unit. Each question will carry equal marks.

Total marks: 20

Section-B: This section have 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit. Each question will carry equal marks.

Total marks: 80

M.A./M.Sc. MATHEMATICS SEMESTER – I (2025-26)

MATH 1C1 – ALGEBRA I

Unit - I

Linear transformations, Range, Kernel, Rank-nullity theorem, Singular and nonsingular transformations, Vector space of linear transformations. Adjoint of a linear transformations. Matrix representation of a linear transformation, Change of Basis. Transition matrix, Similarity, Eigen values and Eigen vectors for a linear transformation, Cayley-Hamilton Theorem.

Unit-II

Bilinear form, its matrix representation and rank, Canonical forms, Diagonalization, Quadratic form associated with a bilinear form, Symmetric matrix associated with a quadratic form.
Diagonalization of a quadratic form, Hermitian form and its matrix representation.

Unit - III

Inner product spaces, Cauchy-Schwartz inequality, orthogonal vectors. Orthogonal complements, orthonormal sets and bases. Gram Schmidt orthogonalisation process.
Homomorphism theorems on groups, Classes and class equation of a finite group, Sylow's Theorem.

Unit-IV

Cauchy's theorem for finite Abelian group. Normal and Subnormal series, Jordan-Holder Theorem, Solvable groups. Ideals, Principal Ideal rings, Euclidean rings and domains.

Unit V

Unique factorization theorem, unique factorization domain**.** Finite field extension, Galois Theory

References :

1. I.N.Herstien — Topics in Linear Algebra (Wiley Eastern)
2. Sharma &Vashistha — Linear Algebra (Krishna Publication)
3. K Hoffemn & R.Kunje — Linear Algebra (Prentice- Hall India Ltd)
4. A.R.Vashistha — Algebra (Krishna Publications- Meerut)
5. Shanti Naravan — A Text book of Modern Abstract algebra (Wiley Eastern)

MATH 1C2 – ANALYSIS I

Unit-I

Analytic functions, Stereographic projection of complex numbers, Holomorphic complex valued functions and their inverses, Power series. conformal mapping. Bilinear transformations their properties and classification. Special Transforms.

Unit-II

Complex integration, Cauchy Theorem and integral formula, Poisson's integral formula, Tayler's and Laurent's series.

Unit -III

Morera's Theorem. Lioville's Theorem, Maximum modulus principle, Minimal modulus principle, Schwarz's Lemma.

Unit-IV

Classification of Singularities. Branch Points, Reimann Theorem on removable Singularity, open mapping theorem.

Unit - V

Meromorphic functions, The Argument Principle. Roche's Theorem, Residues, Cauchy's residue theorem; evaluation of integrals, Branches of many valued functions with reference to $\arg Z, \log z, z^n$ Analytic Continuation.

References :

1. Malik- Arora — Mathematical Analysis (New Age International Limited)

2. Schaum Series — Complex Variable (TataMcgraw Hill)
3. Churchill & Brown — Complex Analysis (TataMcgraw Hill)
4. Walter Rudin — Real and Complex Analysis (TataMcgraw Hill)

MATH 1C3 - MECHANICS

Unit-I

Moment and product of Inertia- principal axes and Momental Ellipsoid, D'Alembert's principle.

Unit II

Motion about a fixed axis (General equation of motion).

Unit-III

Generalized Coordinates, Holonomic and Non-holonomic systems, Scleronomic and Rheonomic systems, Generalized potential. Lagrange's equations.

Unit-IV

Hamilton's variables, Hamilton canonical equations, Euler's dynamical equations for the motion of a rigid body about an axis.

Unit-V

Hamilton's Principle, Principle of least action. Poisson's Bracket, Poisson's identity, Jacobi-Poisson Theorem, Hamilton Jacobi equations.

References :

1. Goldstein — Classical Mechanics (Narosa Publication)
2. P.P. Gupta — Rigid Dynamics (Krishna Prakashan, Meerut.)
3. M. Ray — Dynamics of Rigid Body (Student's and Friend's, Agra)

MATH 1C4 - METHODS OF APPLIED MATHEMATICS - I

Unit-I

Fredholm and Volterra types Linear Integral Equations, Integral Equations of the first and second kinds, Solution of Fredholm Integral Equations with separable Kernels.

Unit II

Solution by successive substitutions and successive approximations of Fredholm types LinearIntegral Equations. Solution by successive substitutions and successive approximations of Volterra types Linear Integral Equations.

Unit-III

Laplace Transform: - Definition, properties, Laplace transform of derivatives. Laplace Transforms for Integrals, Inverse Laplace Transforms, Convolution theorem, Fourier transform – definition and properties of Fourier Sine and Cosine transform.

Unit IV

Applications of Laplace Transforms to solve Ordinary Differential Equations and Integral Equations.

Unit-V

Hypergeometric Function, Bessel Functions, Legendre Function of first kind.

References :

1. Erwin Kreyszig — Engineering Mathematics(New Age Intern. Limited)
2. M.D.Raisinghania — Integral Transform (S. Chand Pub.)
3. Shanti Swaroop — Integral Equations (Krishna Publication Meerut)
4. Gupta and Goyal — Integral Transform (KrishnaPrakashan Meerut)
5. I N Snedan — Uses of Integral Transform (McGraw Hill)

M.A./M.Sc. MATHEMATICS SEMESTER – II (2025-26)

MATH 2C1 - NUMERICAL ANALYSIS

Unit I

Rate of Convergence of Bisection, Secant method, Regula-falsi, N-R Methods.N-R Method for non linear equation.
Roots of polynomial equations -Bairstaw and Birge-Veta method, Graeffe's root square method.

Unit II

Solution of System of linear equations: Direct methods, Gauss, Gauss-Jordan, Cholesky, Partition, Triangularization method.
Iterative methods: Jacobi, Gauss-Seidal and Relaxation Methods

Unit III

Curve Fitting and Approximation: Least square principle, Chebyshev Approximation Method.
Matrix inversion and Eigen value problem, Power methods, Jacobi method, Complex Eigen values.

Unit-IV

Numerical Solution of Ordinary Differential Equations: Iterative methods –improved Eulermethods. Runge-Kutta methods. Predictor Corrector methods.

Unit V

Stability analysis, Difference methods for Boundary Value Problems (BVP).Numerical Solution of PDE- Finite step method.

References :

1. Jain-Iyenger-Jain — Numerical Analysis (New Age International Limited)
2. Chauhan, Vyas & Soni — Studies in Numerical Analysis (Jaipur Publishing House)
3. Goyel& Mittal — Numerical Analysis (Pragati Prakashan)
4. Gupta& Malik — Calculus of Finite Difference & Numerical Analysis

MATH 2C2 - ANALYSIS II

Unit-I

Riemann- Stieltjes integral, Properties of Improper Integral.

Unit II

Point-wise and uniform convergence of sequence & series of functions, Cauchy criterion, Weirstrass M-test, Abel and Dirchlet test for Uniform Convergence, Uniform Convergence and continuity.

Unit-III

Monotonic functions, Types of discontinuities, Functions of bounded variations, Functions of several variables, Directional Derivatives, Partial Derivatives, Derivative as a linear transformation, Inverse and implicit function theorem.

Unit IV

Measurable sets, Measurable functions. Lebesgue measure. Borel and Lebesgue measurability. Non measurable sets.

Unit-V

Convergence of sequence of measurable functions. Lebesgue integral of a bounded function.

References:

1. Malik- Arora — Mathematical Analysis (New Age International Limited)
2. H.L.Royden — Real Analysis (Macmillen Pub. Co.)
3. Walter Rudin — Real and Complex Analysis (Tata Mcgraw Hill)
4. G N.Purohit — Lebesgue measure & Integration (JPH. Jaipur)

MATH 2C3 - PARTIAL DIFFERENTIAL EQUATIONS

Unit-I

Existence and uniqueness of solution of (dy/dx) = f(x,y). Examples of PDE,Cachy problem for Ist order PDE. Classification. Canonical forms, Nonlinear First Order PDE-Complete Integrals, Envelopes.

Unit -II

Method of solving Second order PDE - separation of variable and Cauchy's problem.Laplace's Equation and its solution in Cartesian and Polar co ordinates.

Unit-III

Heat and Wave Equations in two and three dimension Cartesian coordinates. Heat and Wave Equation in two dimensional polar coordinates, their fundamental solutions by separation of variable.

Unit - IV

Variational of a functional, Euler Lagrange's Equations, Necessary and Sufficient Condition for Extrema, Variational Methods for Boundary Value Problems in Ordinary and Partial Differential equations.

Unit V

Calculus of variations, shortest distance, Minimum surface of revolution, Brachistochrone problem, Isoperimetric problem, Geodesic.

References:

1. 1.Erwin Kreyszig Engineering Mathematics (New Age India Ltd.)
2. 2. M.D. Raisinghania Advanced Differential Equation (S.Chand)

MATH 2C4 - METHODS OF APPLIED MATHEMATICS - II

Unit-I

Set, Relation, function, Principle of inclusion and exclusion, Pigeon-hole principle. propositional calculus : Logic, Validity of Statements, Proof of Implications/Identities

Unit II

Boolean Algebra : Boolean functions and expression, Lattices: Lattice and algebraic structure, duality, distributed and complemented lattice, partially ordered sets.

Unit III

Graph Theory : Graphs. planar graph. Eulerian and Hamiltonian Graph. Directed Graphs, path, circuit, weighted graphs, shortest path problem, coloring of graphs, Region of graphs

Unit IV

Trees: Binary Tree, Binary Search Tree, Design and Implementation of digital networks, Application to switching and Logic circuits.

Unit-V

Fractional derivatives: Grunwald-Letnikov, Riemann-Liouville and Caputo's fractional derivative, Leibniz rule for fractional derivatives, Geometric and physical interpretation of fractional integration and fractional differentiation.

Refrences:

1. Schaum Series Discrete Mathematics (Tata McGraw Hill)
2. C.L.Liu Elements of Discrete Mathematics (Tata McGraw Hill)
3. Kenneth H Rosen Discrete Mathematics (Tata McGraw Hill)
4. M.K.Gupta Discrete Mathematics (Krishna Prakashan Meerut)
5. Kilbas, Srivastav, Trujilo .Theory and Applications of Fractional Differential equations