SHIV NADAR

INSTITUTION OF EMINENCE DEEMED TO BE UNIVERSITY

DELHI NCR

DEPARTMENT OF MATHEMATICS

SCHOOL OF NATURAL SCIENCES

UNDERGRADUATE PROSPECTUS

2025

Contents

Overview of the Department

The Department of Mathematics, established in 2011, is one of the founding departments at the Shiv Nadar Institution of Eminence (Deemed to be university).

The faculty at the department are active researchers in diverse areas such as Functional analysis, Optimization, Algebra, Complex systems, Artificial intelligence, Mathematical finance, Probability, and Statistics. This research transcends into our BSc (Research) Mathematics programme in the form of an undergraduate thesis, which opens up avenues to higher academic degrees, placements, and internships in popular emerging technologies.

Empowerment through rigorous learning and research in fundamental areas of mathematics and emerging technologies is at the core of the undergraduate programme. Students have an opportunity to choose their electives from a wide variety of pure and applied mathematics, Data Science courses to tailor their degree according to their aptitude and ambition, highlighting the interdisciplinary and multidisciplinary nature of the university. The Department offers undergraduate thesis and specializations in Applied algebra, Mathematical finance, Data Science and Advanced Analysis, as a mandatory credit requirement.

The faculty at the Department of Mathematics is constantly striving to explore new and emerging transdisciplinary domains of knowledge which are relevant to societal benefit and sustainable development goals, like Human-nature interaction and Artificial intelligence. Some of the frontier areas in which the faculty has reputed publications include Complex systems modelling, Statistical learning, Minimal surfaces, and Mathematical finance. The Department's engagement with these emerging paradigms of learning promotes novel dimensions to our research focus that transcends to the Doctoral programme which has these as thrust areas in addition to modern areas in Functional analysis, Algebra, Optimization, Geometry, Statistical Inference and Data Driven Modeling.

The Department has been conferred the DST-FIST grant in 2015 towards setting up a Departmental Research Computer Lab, as well as a dedicated Department Library. In addition to organizing the National Conference in Complex Networks and a workshops in Zero Mean Curvature, the Department has been regularly hosting important national conferences and schools such as the Annual Foundational School, and Advanced Instructional School, organized by the National Board of Higher Mathematics.

The department also offers a **Minor in Mathematics** for students not majoring in Mathematics. Students can earn a Minor in Mathematics by earning appropriate course credits from the department.

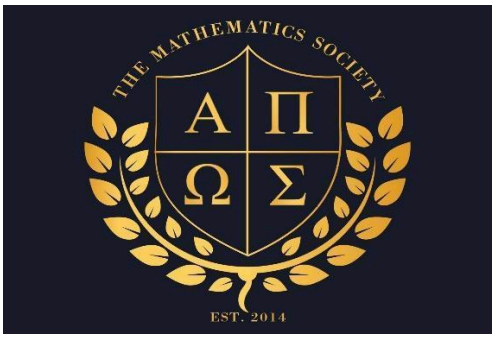
Our alumni have gone on to further studies in mathematics, economics and data analytics in leading institutions like the ETH Zurich, National University of Singapore, University of Bonn, Dublin City University, Institute of Mathematical Sciences (Chennai), Tata Institute of Fundamental Research (Mumbai), University of Göttingen (Germany), Institute of Higher Economics (Russia), Moscow Institute of Physics and Technology (Russia), University of Chicago (USA), Arizona State University (USA), and Delhi School of Economics. Some have taken up jobs in academia as well as in industry.

Department photograph with graduating batch of 2023.

Prof. R. Bapat giving a glimpse of Spectral graph theory to Undergraduate and Graduate students.

Department Library, set up under a DST-FIST grant.

The Department of Mathematics is housed in the School of Natural Sciences.



The Mathematics Society of the department.

Faculty members with the founding batch of BSc (Research) Mathematics 2011.

The Mathematics Lab for Undergraduate students and Scholars.

Outreach Activities of the department for School Students.

Mission of the Undergraduate Program in Mathematics

Our fundamental mission is to empower the students through rigorous training in fundamental areas of mathematics and in emerging technologies. This enables our students to pursue careers and achieve leadership roles in both academia and industry. We promote critical thinking through training in logical reasoning, the nature and types of proof, abstraction, the presentation and analysis of data. We enable students to realize and develop their interests through a diverse set of elective courses as well as opportunities for research with faculty mentors. Students are also exposed to the connections between mathematics and other disciplines.

Our undergraduate program is further distinguished by the following features:

- Melting of the artificial barriers between pure and applied mathematics and between mathematics and other disciplines.
- Training in modern computing skills and applications to real-world problems.
- Accessibility to students from diverse backgrounds.

Learning Outcomes of the Undergraduate Program in Mathematics

Through their study of the core undergraduate mathematics curriculum and their choice of elective courses, all Shiv Nadar University mathematics majors develop their ability to:

- Formulate and express mathematical statements and arguments, translate intuitive understanding into formal definitions and proofs.
- Apply mathematical reasoning to unfamiliar problems and communicate mathematical ideas through oral and written presentations.
- Become adept at the use of programming languages and mathematical software.
- Develop mathematical models for interdisciplinary applications in areas like physics, economics, biology, and data science.
- Show individual ability and creativity through participation in projects and research.

Faculty

The faculty members of the department of mathematics at SNIOE have studied or worked at leading institutions. Their mathematical interests vary widely across pure and applied mathematics.

Faculty Member	Designation	Teaching/Research Interest
Dr. Ajit Kumar	Assistant Professor	Partial Differential Equations, Finite Element Method
Dr. A. Satyanarayana Reddy	Associate Professor	Algebraic Graph Theory, Discrete Mathematics, Algebraic Number Theory
Dr. Amber Habib	Professor	Representation Theory, Mathematical Finance
Dr. Chandranandan Gangopadhyay	Assistant Professor	Algebraic Geometry, Moduli Spaces of Sheaves, Toric Varieties
Dr. Charu Sharma	Assistant Professor	Mathematical Finance, Statistical Modeling
Dr. Indranil Biswas	Senior Professor	Algebraic Geometry, Differential Geometry
Dr. Neha Gupta	Assistant Professor	Integer Partition Theory, Combinatorics, Algebraic Graph Theory, Category Theory, Neural Codes
Dr. Niteesh Sahni	Associate Professor	Artificial Intelligence, Mathematical Modeling, Harmonic Analysis
Dr. Parul Gupta	Assistant Professor	Commutative Algebra, Algebraic Number Theory
Dr. Pradip Kumar	Associate Professor & Undergraduate Advisor	Differential Geometry
Dr. Priyanka Grover	Associate Professor	Matrix Analysis, Operator Theory
Dr. Qazi Azhad Jamal	Assistant Professor	Statistical Inference, Probability Theory, Data-Driven Modeling
Dr. Sanjeev Agrawal	Professor	Functional Analysis, Operator Theory, Error Correcting Codes,

		Encryption, Mathematics Education
Dr. Samit Bhattacharyya	Associate Professor	Applied Mathematics, Computational Biology
Dr. Santosh Singh	Associate Professor	Medical Image Analysis, Image Reconstruction, Filter Bank Theory, Computational Photography, Light Field, Optimization Techniques
Dr. Sneh Lata	Assistant Professor & Graduate Advisor	Frame Theory, Operator Theory, Function Theory
Dr. Somya Singh	Assistant Professor	Interacting Reinforced Stochastic Processes, Urn Models, Random Graphs, Social/Contagion Networks, Opinion Dynamics, Markov Processes
Dr. Sudeepto Bhattacharya	Professor	Complex Systems, Game Theory, Network Theory, Mathematical Modeling
Dr. Sudip Ranjan Bhuia	Assistant Professor	Functional Analysis, Operator Theory, Function Theory
Dr. TSSK Rao	Distinguished Professor & Head	Harmonic Analysis, Approximation Theory

B.Sc. (Research) Mathematics

The basic undergraduate degree program offered by the Department of Mathematics is B.Sc. (Research) in Mathematics. By taking appropriate elective courses, in consultation with the Undergraduate Advisor of the Department, a student can also be eligible for award of one of the following:

- B.Sc. (Research) in Mathematics with a Mathematics Specialization
- B.Sc. (Research) in Mathematics with a Minor

Every mathematics undergraduate student of the University is required to take a number of credits from courses broken up into the following categories:

a) CCC (Core Common Curriculum courses offered by the university)
b) UWE (University Wide Electives; courses designated and offered by departments other than Mathematics)
c) Core Mathematics Courses (“Major Core”)
d) Elective Mathematics Courses (“Major Elective”)

e) Undergraduate Thesis

The minimum credit requirements are described below.

B.Sc. (Research) in Mathematics			
Core Courses	Major Core	76	136
	Major Elective	24	
	End-Course Capstone	12	
	Core-Experiential Learning	8	
Multidisciplinary Courses	Common Core Curriculum (CCC)	16	
	University Wide Curriculum (UWE)	16	24
	CCC / UWE (Floater)	8	
Total Credits			160

The basic degree can be supplemented by **Specializations** in particular aspects of Mathematics and its applications. Four Specializations are available to students admitted to B.Sc. (Research) in Mathematics in 2025:

1. **Mathematical Finance**
2. **Data Science**
3. **Applied Algebra**
4. **Advanced Analysis**

These can be completed using the Elective slots and are described in detail later.

A student must complete all requirements for the degree in a minimum of three years and a maximum of six years.

The **Minor** requirements are set by the department offering it. It is expected that a student will complete the minor by concentrating his/her UWE choices accordingly, though a student may need to take extra UWE credits to complete a particular Minor.

Semester-wise Plan

A typical path through the B.Sc. (Research) in Mathematics program is shown below. Students may be allowed by the Department Undergraduate Committee to alter the sequence of core courses in order to ease goals such as obtaining a Minor from another department, or to complete prerequisites for a summer program or internship.

Similarly, each student will have individually guided choice in timing CCC, UWE and Mathematics Elective courses.

Yr	Monsoon Semester	Credits	Spring Semester	Credits	Summer	Credits

					Semester	
1	Foundations Calculus I Linear Algebra I Number Theory CCC1 EVS	20	Calculus II Algebra I Statistical Thinking and Probability Introduction to Programming UWE1	20	Mathematics in the Modern World I	2
2	Real Analysis I Algebra II Probability and Distributions UWE2 CCC2 CCC3	19	Real Analysis II Numerical Methods Statistical Inference Linear Algebra II CCC4	17.5	Mathematics in the Modern World II	3
3	Differential Equations Mathematical Modelling MAT Elective 1 UWE3 CCC5 CCC6	19	Complex Analysis Undergraduate Seminar MAT Elective 2 UWE4 CCC7 CCC8	19	Mathematics in the Modern World III	3
4	Undergraduate Thesis I MAT Elective 3 MAT Elective 4 MAT Elective 5 CCC9 UWE/CCC	17.5	Undergraduate Thesis II MAT elective 6 UWE/CCC	20		

Most CCC courses are of 1.5 credits and are taught over a half-semester. Some are 3 credits and the compulsory CCC on Environment is of 4 credits. Similarly, UWE courses can have different credits, and are typically for 3 or 4 credits. The UWE and CCC slots shown above are therefore indicative only.

Minor in Mathematics

Undergraduate students of the university who are *not* majoring in Mathematics have the option to take a **Minor in Mathematics**. A Minor in Mathematics can serve two distinct functions (apart from enjoying its beauty and intellectual stimulation!):

- Acquiring the academic background for higher studies in mathematics.
- Acquiring modeling and computational skills for applications of mathematics in other disciplines or in industry.

Academic Requirements:

You have to acquire a minimum of **20 credits as University Wide Electives** (UWE) from the courses offered by the Department of Mathematics. These credits distribution and minimum requirement are as follows:

- **Group A:** Number Theory, Probability and Statistical Thinking, Calculus I, Calculus II, Linear Algebra I, Probability and Distributions, Real Analysis I, Differential Equations, Algebra I, Numerical Methods, Statistical Inference.

- **Group B:** All other MAT courses numbered 200 or above, available as UWE, and not included in Group A.

Requirements: 12 credits (3 courses) from Group A and 8 credits (2 courses) from Group B. At most 8 credits from 100 level courses.

Note: Core courses of a major cannot be used towards Minor for a student pursuing that major.

Your choice of courses is subject to the following restrictions:

- A course cannot count towards both Major and Minor requirements. For example, Economics students cannot count MAT 101 towards the Minor because it is a compulsory course in their Major.

- Certain course combinations are not allowed. If you have already credited a course with significant overlap with a certain MAT course, or a more advanced course than the MAT course, you may not earn credit for the Minor from that MAT course. A list of such banned combinations will be published before each semester's course registration.

The Undergraduate Advisor for Mathematics will help you work out an appropriate choice of courses depending on your interests and background.

Specializations in Mathematics

Students of B.Sc. (Research) in Mathematics can choose to specialize in certain areas, especially in applications of Mathematics.

Choosing a specialization depends largely on a student's interests and the availability of faculty. If you are inclined toward a particular specialization, plan ahead and discuss it with the UG Advisor or relevant faculty members during your early years.

Mathematical Finance is a modern study area where advanced mathematical methods are used to create and add immense value in a practical environment. Typically banks, insurance companies and institutional investors rely on mathematical models to drive both their investment and risk management strategies. The study of Mathematical

Finance provides ample opportunities for continuation into research. Alternatively it can be essential to find employment in many areas in the financial industry.

Data Science specialization equips students with the necessary tools and techniques to apply mathematical concepts to real-world data analysis. By integrating advanced statistical methods, machine learning algorithms, and computational techniques, students will learn how to extract meaningful insights from complex datasets. The program emphasizes the application of mathematical rigor in areas such as predictive modeling, data visualization, and algorithmic problem-solving.

Modern algebra, with its emphasis on the study of relationships and symmetry, has brought greater clarity to all parts of mathematics and its applications. The specialization in **Applied Algebra** offers the opportunity to study several topics in algebra which are especially popular today, with applications as diverse as playing a scratched CD, protecting online transactions, the design of statistical experiments, and representing molecular structures.

Analysis has applications across mathematics as well as in statistics, physics and engineering. Areas such as measure theory, functional analysis, frame theory and matrix analysis are crucial to understanding Statistics, Signals Processing, Control Theory, Quantum Information Theory, Quantum Computing, and the developing field of Uncertainty Quantification.

To obtain a Specialization, the student must complete the credit requirements listed below.

- **Specialization in Mathematical Finance:**
  - MAT 4212 (Introduction to Mathematical Finance)
  - Any three of MAT 4213 (Discrete Time Finance), MAT XXXX (Econometrics), MAT XXXX (Advanced Statistics), MAT 4220 (Machine Learning through R), MAT 4216 (Deep Learning), MAT 4204 (Optimization I), MAT XXXX (Optimization II), MAT 5705 (Stochastic Processes), MAT XXXX (Computational Finance)

- **Specialization in Data Science:**
  - MAT 4100 (Statistical Simulation and Computation)
  - Any three of MAT 4214 (Introduction to Machine Learning), MAT 4215 (Data Mining and its Applications), MAT 4216 (Deep Learning), MAT 4217 (Introduction to Large Language Models), MAT 6404 (Advanced Deep Learning), MAT 6405 (Introduction to Reinforcement Learning)

- **Specialization in Applied Algebra:**
  - Any four of MAT 4206 (Combinatorics), MAT 4207 (Commutative Algebra), MAT 4208 (Graph Theory), MAT 4210 (Game Theory), MAT 5707 (Cryptography), MAT 5708 (Error Correcting Codes), MAT 5709 (Combinatorial Design Theory)

- **Specialization in Advanced Analysis:**
    - MAT 4219 (Metric Spaces)
    - Any three of MAT 5702 (Frame Theory), MAT 5704 (Introductory Matrix Analysis), MAT 6401 (Measure Theory and Integration), MAT 6402 (Topology), MAT 6403 (Functional Analysis)

Apart from the courses listed above that are offered by the Mathematics Department, certain SWAYAM courses may also be counted toward your specialization, subject to approval from the UG Advisor.

Your First Year as a Mathematics Major

The first year of your undergraduate studies will be especially crucial. It typically takes a student this long to transition from doing school mathematics to meeting the much higher expectations of university mathematics. At SNIOE we have taken care to ensure a proper transition so that at the end of the year you are well positioned to embark on a fruitful life with mathematics.

First Semester

Foundations – This course aims at helping the student transition from high school to university. The course covers the fundamentals of the language of mathematics: sets and logic, proofs, relations and functions, mathematical induction, finite and infinite sets. Students are required to create and critique proofs, and to reflect individually and in groups on what it means to think mathematically.

Calculus I – This course covers one variable calculus and applications. It forms the base for subsequent courses in multivariable calculus and real analysis as well as for applications in probability, differential equations, optimization, etc. One of the themes of the course is to bring more rigor to the formulas and techniques students have learned in school.

Linear Algebra I – Linear Algebra provides the means for studying several quantities simultaneously. A good understanding of Linear Algebra is essential in almost every area of higher mathematics, and especially in applied mathematics. This course reviews vectors and matrices and then introduces abstract linear algebra through the special case of finite-dimensional real vector spaces and the linear transformations between such spaces.

Number Theory – This course uses elementary number theory as the ground for exploring enquiry-based learning. It is also an entry point to subsequent courses on algebra and its applications. We also do some basic calculations involved in number theory using computer software, Python.

Second Semester

Calculus II – This is a course on differential and integral multivariable calculus. The concepts and techniques covered here are used extensively in the social and natural sciences as well as in engineering to study systems with many dimensions.

Algebra I – Algebraic structures like groups, rings, fields, vector spaces and modules are fundamental to modern mathematics. The basic building block of these structures is the group. This, a first course in Abstract Algebra, concentrates mainly on groups and their basic properties. We also look to do basic calculations in Group theory in the mathematical software, called GAP. This helps the students look into group theory from a calculative point of view with hands-on experience using computer software.

Statistical Thinking and Probability – This course introduces fundamental probabilistic concepts and statistical reasoning, equipping students with the ability to analyze uncertainty, make data-driven decisions, and apply quantitative methods across various disciplines. It prepares students for advanced coursework in probability, statistics, machine learning, and data science.

Introduction to Computing and Programming – This course provides an introduction to the structure of a computer and the algorithmic approach to solve a problem. Programming concepts are taught using the C language. Students will learn about data types, decision structures, loops, functions, dynamic memory allocation, pointers and data structures.

Apart from these mathematics courses, you should also take 1 CCC (EVS) and 1 UWE course during your first year.

The department also offers CCC as listed below.

CCC XXXX Mathematics in India – Mathematics had a rich history in ancient and medieval India. Indian mathematicians made original contributions to algebra, number theory and geometry; with the Kerala School making fundamental discoveries related to differential calculus and infinite series two centuries before their full development by Newton and Leibniz. This course provides an overview of the story of mathematics in India, and also incorporates the social context and the connections with other cultures.

CCC XXXX Art of Numbers – This course deals with two aspects of numbers. The first part of the course takes up some patterns that exist in nature, to study them and understand some of their applications. The second part looks at numbers as carriers of information. We study some elementary Number theory and basic algorithms involved.

CCC XXXX Data Analysis and Business Modelling Using Excel - The spreadsheet program Excel is used by businesses to summarize, report and analyze data, as well as to build analytic models to help increase profit, reduce cost, or manage operations more efficiently. This course teaches efficient use of tools and methods available in Excel that can save you hours of time and improve approaches for analyzing important business

problems.

CCC XXXX Shapes in Nature – Our world is full of interesting shapes and Mathematics plays an important role in understanding and utilizing them. Conversely, our attempts to understand these shapes lead to new mathematics. This course will consider shapes and patterns that occur in nature, and their properties. For example, the geometry of honeycombs, the patterns of mud cracks etc. will be discussed. Soap films and bubbles and their stability are another fascinating topic with many ramifications.

CCC XXXX Characteristics of Data – This course introduces students to the basic concepts of descriptive data analysis using R software. The focus is on understanding and interpreting data using R's built-in functions, without requiring any coding skills. Through simple, hands-on demonstrations in R, students will learn how to use its interface to summarize and visualize data.

Departmental Activities

The Department of Mathematics was one of the founding departments of Shiv Nadar University. It is also among the largest and most active. We have organized national conferences and summer schools as well as Colloquium talks, weekly seminars, and school workshops.

Student-Centric

- The department has a student-led **Mathematics Society** that independently organizes academic talks, film screenings, problem-solving sessions, and a variety of other mathematical activities.
- The **Opportunities for Undergraduate Research (OUR)** program enables undergraduate students to engage in original, interest-driven research under faculty supervision. Students engage in cutting-edge research projects spanning data science, artificial intelligence, machine learning, financial mathematics, algebra, geometry, and computational modeling, exploring both theoretical foundations and real-world applications.
- The department conducts an **Undergraduate Thesis Expo** competition every year for final year students to showcase their skills and knowledge.

Academic Events

The department regularly hosts national conferences, thematic workshops, and high-quality instructional schools, providing students exposure to the latest developments in mathematics and its applications.

- International Conference on Algebraic and Analytic Geometry (2025)
- National conference on operator theory and function spaces (2024)
- Workshop on Zero Mean Curvature Surfaces (2022)

- Annual Foundation School II (2021), funded by the National Centre for Mathematics
- Annual Conference of Indian Women and Mathematics (2018), funded by the National Board for Higher Mathematics and the International Mathematical Union's Committee for Women in Mathematics
- National Conference on Cross-Disciplinary Applications of Complex Networks (2018), funded by the Science and Engineering Research Board
- Advanced Instructional School in Matrix Analysis (2016), funded by the National Centre for Mathematics
- Mathematical Training and Talent Search Program (2015 and 2016), funded by the National Board for Higher Mathematics
- Annual Foundation School for PhD Students (2015), funded by the National Centre for Mathematics
- Annual Conference of the Ramanujan Mathematical Society (2012)
- Northern Regional Conference of the National Initiative in Mathematics Education (2011), co-hosted with Ambedkar University, Delhi

Collaborations & Visits

The department welcomes leading mathematicians and scientists from premier national and international institutions, enriching the academic environment through invited lectures and research interactions.

Alumni Across the Globe:

Ayanesh Lal (UG student, 2024) selected for a PhD program with, University of Alabama.

Naukshatro Bose (UG student, 2024) selected for Masters in Mathematics International, RPTU Kaiserslautern-Landau

Vishal Chawla (UG student, 2024) selected for Masters in Mathematics, University of Gottingen.

Sankhrithi Krishna (UG student, 2024) selected for M.Sc Banking and Finance, Monash University

Samhitha Prathivadi (2023) Selected for Financial Research Associate, D.E.Shaw (2023-2025) &
Masters Programs at Imperial College and Oxford.

Kunal Anilkumar (2021) selected fot PhD program at University of Potsdam.

Varnana Premanand (2025)
KU Leuven - Master of Mathematics
University of Amsterdam - Masters in Mathematics
Utrecht University - Masters in Mathematical Sciences

Pranav Verma (2025)
Master of Mathematics
ETH Zurich

Course Catalog

Brief descriptions of the core courses offered by the department to its undergraduate majors are given below. (The first year courses were described earlier) The detailed syllabi can be viewed on the SNIOE website.

First Year

- **MAT 1000 – Foundations**
- **MAT 1001 – Calculus I**
- **MAT 1006 – Linear Algebra I**
- **MAT 1005 – Number Theory**
- **MAT 1002 – Calculus II**
- **MAT 2005 – Algebra I**
- **MAT 1007 – Statistical Thinking and Probability**
- **CSD XXXX – Introduction to Programming**

Second Year

- **MAT 2001 – Real Analysis I**
  This course provides a rigorous base for the geometric facts and relations that we take for granted in one-variable Calculus. The main ingredients include sequences; series; continuous and differentiable functions on R; their various properties and some highly applicable theorems. This is the foundational course for further study of topics in pure or applied Analysis, such as Metric Spaces, Complex Analysis, Numerical Analysis, and Differential Equations.

- **MAT 2006 – Algebra II**
  The course continues the work done in MAT 240 - on the one hand by extending the study of groups to include group actions and applications, and on the other by studying the algebraic structures of rings and fields.

- **MAT 2007 – Probability and Distributions**
  This course introduces the theory and application of random variables and probability distributions. Students learn key concepts such as probability mass/density functions, expectation, variance, and common distributions (binomial, Poisson, normal, etc.). Topics include joint, marginal, and conditional distributions, covariance, correlation, and transformations. The course concludes with the Law of Large Numbers and Central Limit Theorem, highlighting their role in understanding randomness and sampling behavior.

- **MAT 2002 – Real Analysis II**
  Continuing the work done in MAT 220 of understanding the rigor behind one-variable Differential Calculus, this course dwells on various aspects of Integration. We also discuss sequences and series of functions; uniform convergence and consequences; some important approximation theorems for continuous functions; and rigorous discussions of some special functions.

- **MAT 2003 – Numerical Methods**
  Numerical Methods takes up the problems of practical computation that arise in various areas of mathematics, such as linear algebra and calculus. The focus is on understanding and implementing algorithms for obtaining approximate solutions.

- **MAT 3001 – Statistical Inference**
  This course provides a rigorous foundation in statistical inference, focusing on estimation and hypothesis testing. Students study sampling distributions, properties of estimators (unbiasedness, consistency, efficiency, sufficiency), and techniques such as method of moments, MLE, and confidence intervals. Key ideas include the Rao-Cramér lower bound, MVUE, and principles of hypothesis testing with classical tests (χ^2, t, F). The course balances theory with application, preparing students for advanced work in statistics and data analysis.

- **MAT 3002 – Linear Algebra II**
  In MAT 160 we studied linear transformations on euclidean space up to the diagonalizability of symmetric operators. In this course we take up vector spaces over

arbitrary fields and more advanced results on expressing linear transformations by simple matrices. The course culminates with the Jordan canonical form and the spectral theorem.

Third Year

- **MAT 3003 – Differential Equations**
  Differential Equations are fundamental to many areas of science. In this course we learn how to solve large classes of them, how to establish that solutions exist in others, and to find numerical approximations when exact solutions can't be achieved. Further, many phenomena which undergo changes with respect to time or space can be studied using differential equations. In this course we will also see many examples of mathematical modeling using differential equations.
- **MAT 3004 – Mathematical Modelling**
  This course is designed to introduce students to fundamental concepts and methods of mathematical modeling through a hands on, project-oriented approach.
- **MAT 4001 – Complex Analysis**
  This course covers the basic principles of differentiation and integration with complex numbers. Topics will be taught in a computational and geometric way. Knowledge of the topology of Euclidean space and differential calculus of several real variables will be assumed.
- **MAT 4000 – Undergraduate Seminar**
  The Undergraduate Seminar is an introduction to the activity of research in mathematics. It helps prepare students for their Undergraduate Thesis by practicing, on a smaller scale, the skills of literature survey, public presentations, mathematical writing and guided research.

Fourth Year

- **MAT 4901- MAT 4902 – Undergraduate Thesis I-II**
  This 2 semester long course can take a variety of forms, from a reading course on advanced topics to computational work in an application of mathematics. MAT499 concludes with the submission of a written report and a public presentation.

Mathematics Elective Courses

The Department offers a wide range of electives that allow students to explore advanced topics in both pure and applied mathematics, as well as emerging areas in Data Science, Machine Learning, and Artificial Intelligence. These courses provide flexibility for students to pursue their interests, deepen their knowledge in specialized domains, and gain interdisciplinary skills aligned with their career goals and research aspirations.

Some Major Electives:

- Combinatorics
- Geometry of Curves and Surfaces
- Hyperbolic Geometry
- Commutative Algebra
- Representation and Recognition in Vision
- Dynamical Systems
- Optimisation I
- Introduction to Mathematical Finance
- Introduction to Machine Learning
- Measure and Probability
- Metric Spaces
- Graph Theory
- Basic Category Theory
- Introduction to Differentiable Manifolds
- Discrete Time Finance
- Game Theory
- Data Mining and its Applications
- Deep Learning
- Introduction to Large Language Models
- Fourier Analysis
- Frame Theory
- Cryptography
- Error Correcting Codes
- Combinatorial Design Theory
- Homological Algebra
- First Course in Operator Theory
- Introductory Matrix Analysis
- Stochastic Processes
- Field Theory
- Bayesian Network Learning
- Measure and Integration
- Topology
- Functional Analysis
- Advanced Deep Learning
- Introduction to Reinforcement Learning
- Algebraic Topology
- Lie Algebras
- Statistical Simulation and
- Computation

The full course catalog is available on the SNIOE website.

Contact Us

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The SNIOE website is https://snu.edu.in/home/. This provides detailed descriptions of the admission process, fees and scholarships, and overall structure and rules of the undergraduate program.