NEP 2.0

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

# New Arts, Commerce, and Science College Ahmednagar (Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

## National Education Policy (NEP)
## Choice Based Credit System (CBCS)

**Programme Framework**

## B. Sc. - I (Mathematics)

**Implemented from**

## Academic Year 2024-25

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

# New Arts, Commerce and Science College, Ahmednagar (Autonomous)

## Board of Studies in Mathematics

| Sr. No. | Name | Designation |
|---|---|---|
| 1. | Dr. S. B. Gaikwad | Chairman |
| 2. | Dr. S. V. Ingale | Member |
| 3. | Mr. S. A. Tarate | Member |
| 4. | Mr. K. A. Kshirsagar | Member |
| 5. | Ms. B. N. Todkari | Member |
| 6. | Ms. D. G. Gade | Member |
| 7. | Mr. A. S. Jadhav | Member |
| 8. | Ms. P. D. Kasule | Member |
| 9. | Ms. P. S. Ansari | Member |
| 10. | Mr. T. A. Bhakare | Member |
| 11. | Mr. H. N. Shaikh | Member |
| 12. | Dr. A. A. Kulkarni | Member |
| 13. | Prof. (Dr). A. V. Mancharkar | Member |
| 14. | Dr. N. S. Darkunde | Academic Council Nominee |
| 15. | Dr. S. B. Bhalekar | Academic Council Nominee |
| 16. | Dr. G. S. Kadu | Vice-Chancellor Nominee |
| 17. | Mr. P. L. Pawar | Alumni |
| 18. | Mr. Shirish Padalkar | Industry Expert |

## 1. Prologue/ Introduction of the programme:

Welcome to the B.Sc. Mathematics Honours and Honours by Research program! This program is designed for students who have a passion for mathematics and wish to pursue an in-depth study of this fascinating field. Through this prologue, let's explore the essence and significance of this program. The B.Sc. Mathematics Honours program offers a comprehensive curriculum that combines core mathematical principles with advanced topics, enabling students to develop a strong foundation in mathematics. This program is specifically tailored for students who are seeking a rigorous academic experience and aspire to pursue higher studies or research in mathematics. The Honours by Research component provides students with an opportunity to delve deeper into a specific area of mathematics under the guidance of experienced faculty members. This research-oriented approach allows students to explore their interests, develop critical thinking skills, and make original contributions to the field of mathematics. It serves as a stepping stone for those considering a career in academia or research.

During the course of the program, students will be exposed to a wide range of mathematical topics, including calculus, algebra, geometry, number theory, mathematical analysis, probability theory, and more. They will acquire both theoretical knowledge and practical problem-solving skills, enabling them to tackle complex mathematical problems and develop analytical thinking abilities. The program emphasizes the development of mathematical reasoning, logical thinking, and the ability to communicate mathematical ideas effectively. Students will engage in rigorous mathematical proofs, problem-solving exercises, and mathematical modeling, fostering their ability to analyze and interpret real-world phenomena using mathematical principles. Through hands-on projects, seminars, and collaborative research opportunities, students will also develop essential skills such as data analysis, computer programming, and numerical methods, which are increasingly important in today's data-driven world. The B.Sc. Mathematics Honours and Honours by Research program aims to cultivate a deep appreciation for the elegance and beauty of mathematics while nurturing the intellectual curiosity and creativity of students. It provides a supportive learning environment where students can interact with faculty members, participate in academic discussions, and engage in a vibrant mathematical community. Upon successful completion of the program, students will be equipped with a solid foundation in mathematics, critical thinking skills, and research experience. Graduates will have a wide range of career options, including pursuing advanced degrees in mathematics or related disciplines, teaching mathematics at the secondary or tertiary level, working in research institutions, or applying their mathematical skills in industries such as finance, technology, data science, and more. We invite you to embark on this exciting journey of discovery and exploration in the field of mathematics. Through the

B.Sc. Mathematics Honours and Honours by Research program, you will develop a profound understanding of mathematics, acquire invaluable skills, and contribute to the advancement of this timeless discipline. Get ready to unlock the wonders of mathematics and make your mark in the world of numbers!

## 2. Programme Outcomes (POs) :

1. Graduates will have a solid foundation in fundamental mathematical concepts, theories, and techniques across various branches of mathematics, including calculus, algebra, geometry, analysis, and discrete mathematics.

2. Students will acquire advanced knowledge in specialized areas of mathematics through coursework, seminars, and research projects.

3. Graduates will develop strong analytical and critical thinking skills, enabling them to analyze complex mathematical problems, identify patterns, and develop logical and rigorous proofs. They will be adept at applying mathematical principles to solve real-world problems.

4. Students will develop exceptional problem-solving skills, both in theoretical and practical contexts. They will be able to formulate and solve mathematical problems using appropriate mathematical techniques and tools.

5. The Honours by Research component of the program will equip students with the necessary skills to conduct independent mathematical research. Graduates will be proficient in formulating research questions, designing experiments or investigations, collecting and analyzing data, and presenting their findings in a coherent and rigorous manner.

6. Students will be capable of formulating mathematical models, interpreting their results, and making informed predictions or decisions based on the models.

7. Students will be able to explain mathematical concepts clearly, write technical reports and research papers, and engage in scholarly discussions.

8. Students will develop proficiency in using mathematical software, programming languages, and computational tools for data analysis, numerical simulations, and mathematical modeling.

9. Students will develop an understanding of the ethical responsibilities and professional standards associated with mathematical research and practice. They will exhibit integrity, intellectual honesty, and respect for intellectual property rights in their work.

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## B. Sc. Programme Framework: Credit Distribution

| Level / Difficulty | Sem | Subject-1 (Selected as Major) | | | | Subject-2 | | Subject-3 | | (SEC) | GE/OE | | IKS | AEC | VEC | CC | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | | P | | T | P | P | T | P | T | P | | | | | |
| Certificate 4.5 / 100 | I | 02 | | 02 | | 02 | 02 | 02 | 02 | - | 02 | | 02 | 02 | 02 | 02 | 22 |
| | II | 02 | | 02 | | 02 | 02 | 02 | 02 | 02 | - | 02 | -- | 02 | 02 | 02 | 22 |
| | | Credits Related to Major | | | | | | Selected as Minor | | | | | | | | | |
| | | Core | | Elective | | VSC | FP / OJT/ CEP/RP | | | | | | | | | | |
| | | T | P | T | P | P | P | T | P | - | P | T | P | - | - | - | - | - |
| Diploma 5.0 / 200 | III | 04 | 02 | -- | | 02 | 02 | 02 | 02 | - | 02 | 02 | | - | 02 | - | 02 | 22 |
| | IV | 04 | 02 | -- | | 02 | 02 | 02 | 02 | - | 02 | | 02 | -- | 02 | - | 02 | 22 |
| Degree 5.5 /300 | V | 06 | 04 | 02 | 02 | 2 | 2 | 02 | - | - | - | - | | 02 | - | - | - | 22 |
| | VI | 06 | 04 | 02 | 02 | 2 | 4 | 02 | - | - | - | - | | - | - | - | - | 22 |
| Total | | 24 | 16 | 04 | 04 | 08 | 10 | 10 | 08 | 04 | 04 | 06 | 08 | 04 | 08 | 04 | 08 | 132 |
| 6.0/400 Honours | VII | 08 | 06 | 02 | 02 | - | RM-04 | | | | | | | | | | | 22 |
| | VIII | 08 | 06 | 02 | 02 | | OJT-04 | | | | | | | | | | | 22 |
| 6.0/400 Honours with Research | VII | 06 | 04 | 02 | 02 | | RM-04 RM-04 | | | | | | | | | | | 22 |
| | VIII | 06 | 04 | 02 | 02 | | RM-08 | | | | | | | | | | | 22 |
| Total | | 40/36 | 28/24 | 08 | 08 | 08 | 18/26 | 10 | 08 | 04 | 04 | 06 | 04 | 04 | 04 | 08 | 04 | 08 | 176 |

# B.Sc. Programme Framework: Course Distribution

| Level / Difficulty | Sem | Subject-1 (Selected as Major) | | | | | | Subject-2 | | Subject-3 | | (SEC) | GE/OE | | IKS | AEC | VEC | CC | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | | P | | | | T | P | P | T | P | T | P | | | | | |
| Certificate 4.5 / 100 | I | 01 | | 01 | | | | 01 | 01 | 01 | 01 | - | 01 | | 01 | 01 | 01 | 01 | 11 |
| | II | 01 | | 01 | | | | 01 | 01 | 01 | 01 | 01 | - | 01 | -- | 01 | 01 | 01 | 11 |
| | | Credits Related to Major | | | | | | Selected as Minor | | | | | | | | | | | |
| | | Core | | Elective | | VSC | FP / OJT/ CEP/RP | | | | | | | | | | | | |
| | | T | P | T | P | P | P | T | P | - | | P | T | P | - | - | - | - | - |
| Diploma 5.0 / 200 | III | 02 | 01 | -- | | 01 | FP-01 | 01 | 01 | - | | 01 | 01 | | - | 01 | - | 01 | 11 |
| | IV | 02 | 01 | -- | | 01 | CEP-01 | 01 | 01 | - | | 01 | | 01 | -- | 01 | - | 01 | 11 |
| Degree 5.5 /300 | V | 03 | 02 | 01 | 01 | 01 | FP-01 | 01 | - | - | | - | - | | 01 | - | - | - | 11 |
| | VI | 03 | 02 | 01 | 01 | 01 | OJT-01 | 01 | - | - | | - | - | | - | - | - | - | 10 |
| Total | | 12 | 08 | 02 | 02 | 04 | 04 | | | 02 | 02 | 03 | 04 | | 02 | 04 | 02 | 04 | 65 |
| 6.0/400 Honours | VII | 03 | 03 | 01 | 01 | - | RM-01 | | | | | | | | | | | | 09 |
| | VIII | 03 | 03 | 01 | 01 | | OJT-01 | | | | | | | | | | | | 09 |
| 6.0/400 Honours with Research | VII | 02 | 02 | 01 | 01 | | RM-01 RM-01 | | | | | | | | | | | | 08 |
| | VIII | 02 | 02 | 01 | 01 | | RM-01 | | | | | | | | | | | | 07 |
| Total | | 18/16 | 14/12 | 04 | 04 | 04 | 06/07 | 06 | 04 | 02 | 02 | 03 | 04 | | 02 | 04 | 02 | 04 | 83/80 |

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## B. Sc. -Mathematics: Credit and Course Distribution in Brackets

| Level / Difficulty | Sem | Subject-1 | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | T | | P | | | | | |
| 4.5 | I | 02 (01) | | 02 (01) | | | | | 04(02) |
| | II | 02 (01) | | 02 (01) | | | | | 04(02) |
| | | Credits Related to Major | | | | | | IKS | |
| | | Core | | Elective | | VSC | FP / OJT/ CEP | | |
| | | T | P | T | P | P | P | T | |
| 5.0 | III | 04(02) | 02(01) | -- | | 02(01) | FP-02(01) | | 10(05) |
| | IV | 04(02) | 02(01) | -- | | 02(01) | CEP-02(01) | | 10(05) |
| 5.5 | V | 06(03) | 04(02) | 02(01) | 02(01) | 02(01) | FP-02(01) | 02(01) | 20 (10) |
| | VI | 06(03) | 04(02) | 02(01) | 02(01) | 02(01) | OJT-04(01) | | 20(09) |
| Total | | 12 | 08 | (02) | (02) | 04 | 04 | (01) | 33 |
| 6.0 | VII | 03 | 03 | (01) | (01) | - | RM-04(01) | | 22(09) |
| | VIII | 03 | 03 | (01) | (01) | | OJT-04(01) | | 22(09) |
| 6.0 | VII | (02) | (02) | (01) | (01) | | RM-04(01) RP-04(01) | | 22(08) |
| | VIII | (02) | (02) | (01) | (01) | | RM-08(01) | | 22(07) |
| | | 18/16 | 14/12 | 04 | 04 | 04 | 06/07 | (01) | 51/48 |

### Programme Framework (Courses and Credits): B. Sc. Mathematics

| Sr. No. | Year | Semester | Level | Course Type | Course Code | Title | Credits |
|---|---|---|---|---|---|---|---|
| 1. | I | I | 4.5 | DSC-01 | BS-MT 111T (A) | Algebra-I | 02 |
| | | | | | BS-MT 111T (B) | Applied Algebra -I | 02 |
| 2. | I | I | 4.5 | DS C-02 | BS-MT 112P (A) | Introduction to 'C' Programming | 02 |
| | | | | | BS-MT 112T (B) | Descriptive Statistics I | 02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **3.** | I | II | 4.5 | DSC-03 | BS-MT 121T (A) | Algebra-II | 02 |
| | | | | | BS-MT 121T (B) | Applied Algebra -I | 02 |
| **4.** | I | II | 4.5 | DSC-04 | BS-MT 122P (A) | Numerical Techniques using SciLab | 02 |
| | | | | | BS-MT 122T (B) | Mathematical Statistics | 02 |
| **5.** | II | III | 5.0 | DSC-05 | BS-MT 231T | Linear Algebra | **02** |
| **6.** | II | III | 5.0 | DSC-06 | BS-MT 232T | Calculus-I | **02** |
| **7.** | II | III | 5.0 | DSC-07 | BS-MT 233P | LaTeX –I (Scientific Writing) | **02** |
| **8.** | II | III | 5.0 | VSC-01 | BS-MT 234P | Mathematical Transforms | **02** |
| **9.** | II | III | 5.0 | FP-01 | BS-MT 235T | Field Project | **02** |
| **10.** | II | IV | 5.0 | DSC-08 | BS-MT 241T | Analytical Geometry/Differential Equations | **02** |
| **11.** | II | IV | 5.0 | DSC-09 | BS-MT 242T | Calculus-II | **02** |
| **12.** | II | IV | 5.0 | DSC-10 | BS-MT 243P | Python Programming I | **02** |
| **13.** | II | IV | 5.0 | VSC-02 | BS-MT 243T | Machine Learning- I | **02** |
| **14.** | II | IV | 5.0 | CEP-01 | BS-MT 245P | Community Engagement Project | 02 |
| **15.** | III | V | 5.5 | DSC-11 | BS-MT 351T | Multivariable Calculus | 02 |
| **16.** | III | V | 5.5 | DSC-12 | BS-MT 352T | Real Analysis-I | 02 |
| **17.** | III | V | 5.5 | DSC-13 | BS-MT 353T | Metric Space | 02 |
| **18.** | III | V | 5.5 | DSC-14 | BS-MT 354P | Ordinary Differential Equations | 02 |
| **19.** | III | V | 5.5 | DSC-15 | BS-MT 355P | Operations Research | 02 |
| **20.** | III | V | 5.5 | DSE-01 | BS-MT 356T | Group Theory | 02 |
| **21.** | III | V | 5.5 | DSE-02 | BS-MT 357P | Combinatorics | 02 |
| **22.** | III | V | 5.5 | VSC-03 | BS-MT 358P | Machine Learning- II | 02 |
| **23.** | III | V | 5.5 | FP-02 | BS-MT 359P | Python Programming II | 02 |
| **24.** | III | V | 5.5 | IKS-02 | BS-MT 360T | Vedic Mathematics | 02 |
| **25.** | III | VI | 5.5 | DSC-16 | BS-MT 361T | Complex Analysis | 02 |
| **26.** | III | VI | 5.5 | DSC-17 | BS-MT 362T | Real Analysis-II | 02 |
| **27.** | III | VI | 5.5 | DSC-18 | BS-MT 363T | Ring Theory | 02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **28.** | III | VI | 5.5 | DSC-19 | BS-MT 364P | Partial Differential Equations | 02 |
| **29.** | III | VI | 5.5 | DSC-20 | BS-MT 365P | Optimization Techniques | 02 |
| **30.** | III | VI | 5.5 | DSE-03 | BS-MT 366T | Computational Geometry | 02 |
| **31.** | III | VI | 5.5 | DSE-04 | BS-MT 367P | Number Theory | 02 |
| **32.** | III | VI | 5.5 | VSC-04 | BS-MT 368T | Graph Theory | 02 |
| **33.** | III | VI | 5.5 | OJT-01 | BS-MT 369T | OJT | 04 |

**B. Sc. Mathematics (Honours)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **34.** | IV | VII | 6.0 | DSC-21 | BS-MT 471T | Linear Algebra | 03 |
| **35.** | IV | VII | 6.0 | DSC-22 | BS-MT 472T | Real Analysis | 03 |
| **36.** | IV | VII | 6.0 | DSC-23 | BS-MT 473T | Group Theory | 02 |
| **37.** | IV | VII | 6.0 | DSC-24 | BS-MT 474P | Advanced LaTeX | 02 |
| **38.** | IV | VII | 6.0 | DSC-25 | BS-MT 475P | Integral Equations | 02 |
| **39.** | IV | VII | 6.0 | DSC-26 | BS-MT 476P | Lab for Numerical Linear Algebra | 02 |
| **40.** | IV | VII | 6.0 | DSE-05 | BS-MT 477T | Ordinary Differential Equations | 02 |
| **41.** | IV | VII | 6.0 | DSE-06 | BS-MT 478T | Multivariable Calculus | 02 |
| **42.** | IV | VII | 6.0 | RM-01 | BS-MT 479T | Research Methodology and Computer Applications | 04 |
| **43.** | IV | VIII | 6.0 | DSC-27 | BS-MT 481T | Topology | 03 |
| **44.** | IV | VIII | 6.0 | DSC-28 | BS-MT 482T | Advanced Complex Analysis | 03 |
| **45.** | IV | VIII | 6.0 | DSC-29 | BS-MT 483T | Ring Theory | 02 |
| **46.** | IV | VIII | 6.0 | DSC-30 | BS-MT 484T | Advanced Numerical Analysis | 02 |
| **47.** | IV | VIII | 6.0 | DSC-31 | BS-MT 483T | Advanced Operations Research | 02 |
| **48.** | IV | VIII | 6.0 | DSC-32 | BS-MT 484T | Mathematical Statistics | 02 |
| **49.** | IV | VIII | 6.0 | DSE-07 | BS-MT 485T | Partial Differential Equations | 02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **50.** | IV | VIII | 6.0 | DSE-08 | BS-MT 485T | Coding Theory | 02 |
| **51.** | IV | VIII | 6.0 | OJT-02 | BS-MT 486T | OJT | 04 |

**B. Sc. Mathematics (Honours with Research)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 34. | IV | VII | 6.0 | DSC-21 | BS-MT 471T | Linear Algebra | 03 |
| 35. | IV | VII | 6.0 | DSC-22 | BS-MT 472T | Real Analysis | 03 |
| 36. | IV | VII | 6.0 | DSC-23 | BS-MT 473P | Group Theory | 02 |
| 37. | IV | VII | 6.0 | DSC-24 | BS-MT 474P | Advanced LaTeX | 02 |
| 38. | IV | VII | 6.0 | DSE-05 | BS-MT 473T | Integral Equations | **02** |
| 39. | IV | VII | 6.0 | DSE-06 | BS-MT 474P | Ordinary Differential Equations | **02** |
| 40. | IV | VII | 6.0 | RM-01 | BS-MT 476T | Research Methodology and Computer Applications | 04 |
| 41. | IV | VII | 6.0 | RP-01 | BS-MT 477T | PROJECT | 04 |
| 42. | IV | VIII | 6.0 | DSC-19 | BS-MT 481T | Topology | 03 |
| 43. | IV | VIII | 6.0 | DSC-20 | BS-MT 482T | Advanced Complex Analysis | 03 |
| 44. | IV | VIII | 6.0 | DSC-21 | BS-MT 483T | Ring Theory | 02 |
| 45. | IV | VIII | 6.0 | DSE-04 | BS-MT 485T | Advanced Numerical Analysis | 02 |
| 46. | IV | VIII | 6.0 | DSE-07 | BS-MT 473T | Mathematical Statistics | **02** |
| 47. | IV | VIII | 6.0 | DSE-08 | BS-MT 474P | Advanced Operations Research | **02** |
| 48. | IV | VIII | 6.0 | PR-02 | BS-MT 486T | PROJECT | 08 |

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

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**(Autonomous)**

**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Algebra I** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: I | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-01** | BS-MT 111T(A) | 02 | 00 | 02 | 30 | 15 | 35 | 50 |

**Learning Objectives:**

1. To introduce students with basic concepts in mathematics such as sets, relations and functions.
2. To introduce integers, complex numbers and matrices as important examples to study different algebraic structures.
3. To develop the knowledge, skills and aptitude necessary to pursue future study in mathematics.
4. Employ DeMoivre's theorem in the number of applications to solve numerical problems.

**Course Outcomes (Cos):** On completion of the course, students will be able to understand

1. Various properties of relations and functions.
2. Greatest common divisor, Least common multiple, and properties of divisibility.
3. Geometry of complex numbers and application of complex numbers in finding the roots of polynomials.
4. Basic properties of matrices and types of matrices.

**Detailed Syllabus:**

**Unit 1: Sets, Relation and Functions (08 Hrs.)**

1.1. Sets and their representations, types of sets.

1.2. Subsets of the set of real numbers, especially intervals (with notations), power set, universal set, Venn diagrams, union and intersection of sets, difference of sets. complement of a set, properties of complement sets.

1.3. Ordered pairs, cartesian product of sets, cardinality of sets, power sets, equivalence relations, partial order relation.

1.4. Definition of a function, domain, co-domain and the range of a function, types of function, composition of functions, invertible functions and the inverse of a function.

**Unit 2: Integers (08 Hrs.)**

2.1 Well Ordering Property (W.O.P) for N.

2.2 Divisibility in Z: Definition and elementary properties.

2.3 Division Algorithm, G.C.D.and L.C.M of two integers, basic properties of G.C.D., Euclidean Algorithm(statement only).

2.4 Primes, Euclid's Lemma, unique factorization theorem(statement only).

**Unit 3: Complex Numbers (08 Hrs.)**

3.1 Definition of complex number, sum and products, basic algebraic properties.

3.2 Complex conjugates, exponential form, product and quotient.

3.3 DeMoivre's theorem(statement only) and its examples.

3.4 Roots of complex number: the $n^{th}$ roots of unity.

**Unit 4: Matrices (06 Hrs.)**

4.1 Definition of Matrix and its properties.

4.2 Determinant , properties of determinant and transpose of matrix, trace of matrix.

4.3 Square matrices, inverse of matrices by using adjoint method.

4.4 Special types of matrices(Symmetric Matrix, skew-symmetric matrix, orthogonal matrix, Hermitian matrix, skew-Harmitian matrix).

**Suggested Readings/Material:**

1. Introduction to Real Analysis, R. G. Bartle and D. R. Sherbert, John Wiley and Sons Inc, fourth edition, 2010.
2. Complex Variables and Applications : Ruel. V.Churchill; McGraw Hill Co, eighth edition, 2009.
3. Ivan Niven & H.S. Zuckerman, An introduction to number theory (Wiley Eastern Limited), (Fifth edition), 1991.
4. Elementary Linear Algebra with Application, H. Anton, C Rorres, Wiley Seventh edition,1994.

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**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Applied Algebra-I** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: I | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-01** | BS-MT 111T(B) | 02 | 00 | 02 | 30 | 15 | 35 | 50 |

**Learning Objectives:**

1. This course to learn how Matrix Algebra is ubiquitous in Mathematics and therefore a strong foundation has to be laid in studying the abstract algebraic concepts intertwining geometric ideas.
2. Evaluate mathematical expressions to compute quantities that deal with linear systems.
3. Practice using row operations to solve systems of equations and understand echelon forms.
4. Understand the geometric interpretation of determinants in relation to volume and linear transformations.

**Course Outcomes (Cos)**

1. Earn methods to solve systems of linear equations using row reduction and matrix algebra.
2. Demonstrate proficiency in determining the inverse of matrices and recognize the conditions under which matrices are invertible, utilizing techniques such as Gaussian elimination and elementary row operations.
3. To develop the knowledge, skill and aptitude necessary to pursue further study of mathematics.
4. Use LU decomposition to efficiently solve linear equations and understand linear independence.
5. Understand determinants and how they relate to volume and solving systems of equations using Cramer's rule.

**Detailed Syllabus:**

**Unit 1 : Introduction** **(08 Hrs.)**

1.1 Matrix Operations

1.2 Types of Matrices

1.3 The Inverse of a Matrix

1.4 Characterization of invertible matrices

**Unit 2 : Determinants** **(06 Hrs.)**

2.1 Introduction to determinants

2.2 Properties of determinants

2.3 Cramer's rule,

2.4 Volume and linear transformations

**Unit 3 : Linear Equations in Linear Algebra-I (08 Hrs.)**

3.1 System of Linear equations

3.2 Row reduction and echelon forms

3.3 Vector equations

3.4 The matrix equation Ax=b

3.5 Solution sets of linear systems

**Unit 4 : Linear Equations in Linear Algebra -II (08 Hrs.)**

4.1 Partitioned Matrices

4.2 Matrix factorization [Lu decomposition]

4.3 Linear Independence

4.4 Introduction to linear transformation

4.5 The matrix of linear transformation

**Suggested Readings/Material:**

1. Linear Algebra and its Applications, David C Lay, Steven R. Lay, Judi J. MacDonald Pearson Publication,2016, Fifth Edition.
2. Elementary Linear Algebra with supplemental Applications, Howard Anton and others, Wiley Student Edition.
3. Matrix and Linear Algebra (aided with MATLAB), Kanti Bhushan Datta, Eastern Economic Edition.

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**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Introduction to C Programming** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: I | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-02** | BS-MT 112P(A) | 00 | 02 | 02 | 60 | 15 | 35 | 50 |

**Learning Objectives:**

1. To introduce the foundations of computing, programming and problem solving using computers.
2. To develop the ability to analyze a problem and devise an algorithm to solve it.
3. To formulate algorithms, pseudocodes and flowcharts for arithmetic and logical problems.
4. To understand structured programming approaches.
5. To develop the basic concepts and terminology of programming in general.

**Course Outcomes (Cos):** On completion of the course, students will be able to

1. Implement algorithms in C language.
2. Test, debug and execute programs.
3. Explore algorithmic approaches to problem solving.
4. Develop modular programs using control structures.
5. Develop programs using functions.

**Detailed Syllabus:**

**Practical 1:** Introduction of C language using pseudo code.

**Practical 2:** Use of Data types and simple operators.

**Practical 3:** Decision control statements(simple 'if', 'if-else').

**Practical 4:** Decision control statements(nested-if).

**Practical 5:** Decision control statements(switch case).

**Practical 6:** Use of 'while' loop.

**Practical 7:** Use of 'do while' loop.

**Practical 8:** Use of 'for' loop.

**Practical 9:** Programs using standard library functions.

**Practical 10:** Introduction to user defined functions

**Practical 11:** Types of user defined functions

**Practical 12:** Recursive functions.

**Suggested Readings/Material:**

1. The C Programming Language. By Brian W. Kernighan, Dennis M. Ritchie.
2. Programming in C, A Practical approach, Ajay Mittal, Pearson.
3. C, the complete reference, Schildt Herbert, 4th edition, Mc-Graw Hill.
4. Let Us C,Yashavant Kanetkar,BPB publicatiions

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**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Descriptive Statistics-I** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: I | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-02** | BS-MT 112T(B) | 02 | 00 | 02 | 30 | 15 | 35 | 50 |

**Learning Objectives:**

1. Define mean, median, mode, range, variance, and standard deviation.
2. Demonstrate an understanding of descriptive statistics.
3. Explain the difference between descriptive statistics and inferential statistics.

**Course Outcomes (Cos)**

1. To develop the knowledge, skill and aptitude necessary to pursue further study of statistics.
2. To develop problem solving abilities using a computer
3. By learning this course student will be able to apply these methods to real life situation draw
4. Learn how to calculate measures of central tendency and measures of dispersion.
5. Students will be able to draw the descriptive statistics for the data and interpret the data with the appropriate graphs.

**Detailed Syllabus:**

**UNIT1: Data Condensation and Presentation of Data (5Hrs)**

1.1 Definition, importance, scope and limitations of statistics.

1.2 Data Condensation.

1.3 Graphical Representation

**UNIT2: Descriptive Statistics (12Hrs)**

2.1 Measures of central tendency:Concept of central tendency

2.2 Arithmetic mean: Definition, computation for ungrouped and grouped data, properties of arithmetic mean (without proof) combined mean, weighted mean, merits and demerits.

2.3 Median and Mode: Definition, formula for computation for ungrouped and grouped data, graphical method, merits and demerits. Empirical relation between mean, median and mode (without proof)

2.4 Partition Values: Quartiles, Box Plot.

2.5 Concept of dispersion, requisites of good measures of dispersion, absolute and relative measures of dispersion.

2.6 Measures of dispersion : Range and Quartile Deviation definition for ungrouped and grouped data and their coefficients, merits and demerits,
Variance and Standard deviation: definition for ungrouped and grouped data, coefficient of variation, combined variance & standard deviation, merits and demerits.

**UNIT 3: Moments, Skewness and Kurtosis (8Hrs)**

3.1 Concept of Raw and central moments: Formulae for ungrouped and grouped data (only first four moments), relation between central and raw moments upto fourth order. (without proof)

3.2 Measures of Skewness: Types of skewness, Pearson and Bowley's coefficient of skewness, Measure of skewness based on moments.

3.3 Measure of Kurtosis: Types of kurtosis, Measure of kurtosis based on moments.

**UNIT 4:Theory of Attributes (5Hrs)**

4.1 Attributes: Concept of a Likert scale, classification, notation of manifold classification, dichotomy, class- frequency, order of a class, positive classfrequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to two attributes)

4.2 Consistency of data upto 2 attributes.

4.3 Concepts of independence and association of two attributes.

4.4 Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation.

## References:


1. Statistical Methods, George W. Snedecor, William G, Cochran, John Wiley &sons
2. Programmed Statistics, B.L. Agarwal, New Age International Publishers.
3. Modern Elementary Statistics,Freund J.E. 2005, PearsonPublication
4. Fundamentals of Applied Statistics(3rd Edition), Gupta and Kapoor, S.Chand and Sons, New Delhi, 1987.
5. An Introductory Statistics ,Kennedy and Gentle

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**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Algebra-II** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: II | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| DSC-03 | BS-MT 121T(A) | 02 | 00 | 02 | 30 | 15 | 35 | 50 |

**Learning Objectives:**

1. Analyze conditional statements and identify their components (antecedent, consequent).Demonstrate the understanding of converse, contrapositive, and inverse of conditional statements.
2. Classify functions as algebraic or transcendental.Solve trigonometric inequalities.
3. Analyze the relationship between the roots and coefficients of polynomial equations.
4. Represent systems of linear equations in matrix form.Apply Gaussian elimination method to solve systems of linear equations

**Course Outcomes (Cos)**

1. Students will be able to understand and apply the principles of propositional logic to solve problems and analyze statements.
2. Students will be able to analyze and graph algebraic, transcendental, and trigonometric functions, and solve equations graphically
3. Students will understand the properties and applications of polynomials, including factorization and the relationship between roots and coefficients.
4. Students will be able to solve systems of linear equations using various methods and understand the concept of matrix representation.

**Detailed Syllabus:**

**Unit 1: Mathematical Logic** **(06 Hrs.)**

1.1 Propositional Logic

1.2 Propositions

1.3 Conditional Statements

1.4 Converse, Contrapositive and inverse

1.4 Truth Tables of Compound Propositions

**Unit 2: Tracing of Curves** **(08 Hrs.)**

2.1 Algebraic function

2.2 Transcendental function

2.3 Trigonometric inequalities

2.4 Solving functions graphically

**Unit 3: Polynomial (08 Hrs.)**

3.1 Polynomials, The remainder and factor theorem, Synthetic division,

3.2 Factored form of a polynomial,

3.3 Fundamental theorem of algebra,

3.4 Relations between the roots and the coefficients of polynomial equations

**Unit 4: System of linear equations (08 Hrs.)**

4.1 System of m linear equations in n unknowns; Homogeneous systems, Non homogeneous system, Matrix form of System of Equations

4.2 Echelon form; row reduced echelon form of a matrix Definition of rank of a matrix. Examples.

4.3 Gauss Elimination Method, Gauss Jordan Method

4.4 Consistency of a system of non homogeneous equations; Condition of consistency i.e. for $AX = B$, $\rho[A,B] = \rho[A]$ (without proof).

**Suggested Readings/Material:**

1. Kenneth H. Rosen Discrete Mathematics and Its Applications Seventh Edition.
2. Amit M Agarwal Play With Graphs .
3. First Course in the Theory of Equations, Dickson, Leonard Eugene (2009).
4. Matrices : Shanti Narayan; S.Chand & Co. N.Delhi

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**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Applied Algebra-II** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: I | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-01** | BS-MT 121T(B) | 02 | 00 | 02 | 30 | 15 | 35 | 50 |

**Learning Objectives:**

1. Understand vector spaces, subspaces, null spaces, and column spaces.
2. Identify linearly independent sets, bases, and calculate the dimension of a vector space.
3. Define eigenvalues, eigenvectors, and perform diagonalization of matrices.
4. Apply orthogonality concepts including inner products, orthogonal sets, and projections.
5. Comprehend geometric concepts in vector spaces such as affine combinations, independence, and convex combinations.

**Course Outcomes (Cos)**

1. Demonstrate proficiency in fundamental concepts of vector spaces and their applications.
2. Analyze and solve problems involving eigenvalues, eigenvectors, and diagonalization.
3. Apply orthogonality principles to solve problems related to vectors and matrices.
4. Utilize geometric concepts effectively in analyzing vector spaces and their properties.
5. Demonstrate the ability to apply learned concepts to real-world problems in mathematics and related fields.

**Detailed Syllabus:**

**Unit 1: Vector Spaces** **(08 Hrs.)**

1.1 Vector spaces and subspaces

1.2 Null spaces, column spaces and linear transformations.

1.3 Linearly independent sets: Bases

1.4 Coordinate systems

1.5 The dimension of a vector space

1.6 Rank

**Unit 2: Eigenvalues and Eigenvectors (08 Hrs.)**

2.1 Eigenvalues and Eigenvectors

2.2 The characteristic equation

2.3 Diagonalization

2.4 Eigenvectors and Linear transformations

2.5 Applications of eigenvalue and eigenvector

**Unit 3: Orthogonality and Symmetric Matrices (08 Hrs.)**

3.1 Inner product, length and orthogonality

3.2 Orthogonal sets

3.3 Orthogonal Projections

3.4 Diagonalization of Symmetric Matrices

3.5 Applications of orthogonality and symmetric matrices

**Unit 4: The Geometry of vector spaces (06 Hrs.)**

4.1 Affine combinations

4.2 Affine independence

4.3 Convex combinations

4.4 Examples and Applications

**Suggested Readings/Material:**

1. Linear Algebra and its Applications (5th Edition) David C Lay, Steven R. Lay, Judi J. MacDonaldPearson Publication, Fifth Edition, 2016.
2. Elementary Linear Algebra with supplemental Applications, by Howard Anton and others,Wiley Student Edition, Fourth edition.
3. Matrix and Linear Algebra (aided with MATLAB), byKantiBhushanDatta, Eastern Economic Edition, Fourth edition.

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**Syllabus**

# B. Sc. -I (Mathematics)

| **Title of the Course: Numerical Techniques using SciLab** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: II | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-03** | **BS-MT 122P(A)** | 00 | 02 | 02 | 60 | 15 | 35 | 50 |

**Learning Objectives:**

1. Understand the basic syntax and functionality of Scilab.
2. Generate 2-D and 3-D plots for standard functions to visualize data and functions.
3. Understand the principles and application of these numerical methods for solving mathematical problems.
4. Understand how these techniques approximate definite integrals and their applications in real-world problems.

**Course Outcomes (Cos)**

1. Understanding the theoretical and practical aspects of the use of numerical methods.
2. Implementing numerical methods for a variety of multidisciplinary applications.
3. Establishing the limitations, advantages and disadvantages of numerical methods.
4. Understand the fundamental concepts of mathematical functions and their applications in various fields.
5. Understand the concept of continuity and its implications in mathematical functions.

**Detailed Syllabus:**

**Practical 1:** Introduction of scilab with some basic commands

e.g., size, length, eye, ones, rand, zeros etc.

use of ' deff ' command for one and two variable functions.

**Practical 2:** Basic operations on matrices.

e.g., addition, subtraction, multiplication, square etc.

solution for the system of linear equations.

Draw 2-D and 3-D graph for some standard functions

**Practical 3:** Scilab programming: Bisection Method

**Practical 4:** Scilab programming: Regula-Falsi Method

**Practical 5:** Scilab programming: Newton-Raphson Method

**Practical 6:** Scilab programming: Newton's forward interpolation formula.

**Practical 7:** Scilab programming: Newton's backward interpolation formula.

**Practical 8:** Scilab programming: Numerical Integration by Trapezoidal method.

**Practical 9:** Scilab programming: Numerical Integration by Simpson's (1/3)rd rule.

**Practical 10:** Scilab programming: Numerical Integration by Simpson's (3/8)th rule.

**Practical 11:** Scilab programming:Euler's Method

**Practical 12:** Scilab programming:Runge-Kutta Method

**Suggested Readings/Material:**

1. A textbook of Computer Based Numerical and Statistical Techniques, by A. K. Jaiswal and Anju Khandelwal. New Age International Publishers.
2. Numerical Methods For Engineers S. C. Chapra And R. P. Canale McGraw Hill, New York 5th Edition 2006 ISBN: 0071244298
3. H.C. Saxena; Finite differences and Numerical Analysis, S. Chand and Company.
4. K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications

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# B. Sc. -I (Mathematics)

| **Title of the Course: Mathematical Statistics.** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year: I** | | | | Semester: II | | | | |
| Course Type | Course Code | Credit Distribution | | Credits | Allotted Hours | Allotted Marks | | |
| | | Theory | Practical | | | CIE | ESE | Total |
| **DSC-03** | **BS-MT 122T(B)** | 02 | 00 | 02 | 30 | 15 | 35 | 50 |

**Learning Objectives:**

1. Describe a data set including both categorical and quantitative variables to support or refute a statement
2. To develop a students with the problems related to Permutation, Combination.
3. To Build an understanding of the fundamental concept of Probability Theory.

**Course Outcomes (Cos)**

1. To develop the knowledge, skill and aptitude necessary to pursue further study of mathematics.
2. To develop problem solving abilities using a computer.
3. Use basic probability rules including Additive and Multiplicative laws using the terms independent and Mutually Exclusive events.
4. Understand the concept of discrete and continuous random variables.

**UNIT 1: Theory of Probability (9Hrs)**

1.1 Counting Principles, Permutation, and Combination.

1.2 Deterministic and non-determination models.

1.3 Random Experiment, Sample Spaces (Discrete and continuous)

1.4 Events: Types of events, Operations on events.

1.5 Probability - classical definition, probability models, axioms of probability, probability of an event.

1.6 Theorems of probability (without proof)

**UNIT 2: Conditional Probability and Independence (6Hrs)**

2.1 Concepts and definitions of conditional probability, multiplication theorem

2.2 Bayes' theorem (without proof). True positive , false positive and sensitivity of test as application of Bayes' theorem.

2.3 Concept of Posterior probability, problems on posterior probability.

2.4 Concept and definition of independence of two events.

**UNIT 3: Random Variable (6Hrs)**

3.1 Definition of random variable (r.v.) , discrete and continuous random variable.

3.2 Definition of probability mass function (p.m.f.) of discrete r.v. and Probability density function of continuous r.v..

3.3 Cumulative distribution function (c.d.f.) of discrete and their properties.

3.1 Definition of expectation and variance of discrete r.v ,theorem on expectation and variance (statement only).

3.4 Determination of median and mode using p.m.f. only

**UNIT 4 : Standard Discrete Distributions (9Hrs)**

4.1 Discrete Uniform Distribution: definition, mean, variance.

4.2 Binomial Distribution: definition, mean, variance, additive property, Bernoulli distribution as a particular case with n = 1.

4.3 Geometric Distribution (p.m.f $p(x) = pq^x$ , x = 0,1,2..... ): definition,mean, variance.

4.4 Poisson Distribution: definition, mean, variance, mode, additive property, limiting case of B(n, p)

* Only statement of mean and variance, derivation is not expected.

## References:

1. A First course in Probability, Sheldon Ross.Pearson Education Inkc.

2. Statistical Methods (An IntroductoryText), Medhi J. 1992 , New Age International.

3. Modern Elementary Statistics ,Freund J.E. 2005, Pearson Publication.

4.Probability, Statistics, Design of Experiments and Queuing Theory with Applications of Computer Science Trivedi K.S. 2001, Prentice Hall of India, New Delhi.

5. Fundamentals of Mathematical Statistics(3rd Edition), Gupta S. C. and Kapoor V. K.1987 S. Chand and Sons, New Delhi.
6. Mathematical Statistics (3rd Edition), Mukhopadhyay P. 2015, Books And Allied (P), Ltd.