

Gujarat University

NEP 2020 Based Syllabus

Syllabus for B. Sc. Sem-IV Mathematics Major

Effective from June-2024



Syllabus for B Sc Semester - IV (MATHEMATICS)

Mathematics Major

Course-DSC-C-MAT-241T

Paper Title: LINEAR ALGEBRA-II

UNIT I (IKS)

a) Matrices & Determinants (in context of IKS): Introduction and History of Matrices and Determinants, Properties of determinant, Vedic methods to solve 3×3 and 4×4 determinants (Urdhva Tiryagbhyam), Inverse of Matrices

b) System of simultaneous linear equations by Vedic sutras (in the context of IKS):

Paravartya Yojayet, Anurupyate Sunyamanyat, Sankalana Vyavakalana-bhyam

UNIT II The Space $L(U,V)$ and Inner product space:

The Space $L(U,V)$:

The space $L(U,V)$, Operator equation, linear functional, Dual spaces, Dual Basis Existence Theorem, Bilinear forms.

Inner Product Space:

Inner product and Inner product space-examples, results. Norm of a vector.

UNIT III Results on Norm, Orthogonalization and Orthonormalization.

Cauchy-Schwartz inequality, Triangle inequality.

Gram Schmidt orthogonalization process, orthogonalization and orthonormalization of basis, orthogonal complement and its properties, orthogonal transformations.

Determinant and Cramer's Rule.

Determinants and their properties, value of determinant, Basic results, Laplace expansion, Cramer's rule.

UNIT IV Eigen Value/Vector of Linear Operator and Square Matrices and Diagonalization of Matrices:

Eigenvalues and Eigenvectors of linear operators and of symmetric linear maps

Eigenvalues and Eigenvectors of square matrices and of real and symmetric matrices.

Caley-Hamilton's Theorem and Examples on verification of Caley-Hamilton's Theorem.

Matrix inversion of nonsingular square matrices using Caley-Hamilton's Theorem.

Application to reduction of Quadrics, classification of Quadrics,

Diagonalization of real and symmetric Matrices, Spectral Theorem.

Reference books

- 1) An Introduction to Linear Algebra by V. Krishnamurthy, V P Mainra, J L Arora, East-West press Pvt Ltd., New Delhi)
- 2) Linear Algebra Geometric Approach by S. Kumaresan, PHI New Delhi.
- 3) Vertically and Crosswise by A. Nicolas, K. Williams, J. Pickles, Inspiration Books Publication, 2010.

(https://vedicmaths.org/images/PDFs/Free_Books/Vertically%20and%20Crosswise.pdf)

Syllabus for B Sc Semester - IV (MATHEMATICS)

Mathematics Major

Course-DSC-C-MAT-242T

Paper Title: RING THEORY

Unit I Rings and Integral Domain:

Rings: Definition and examples, commutative ring, division ring, unity and unit elements of a ring, Field, properties of a ring, Boolean ring, Finite rings.

Integral Domain: Zero divisor, Definition and examples of Integral Domain (Finite and of infinite order), Characteristic of a ring.

Unit II Subrings and Ring Homomorphism:

Subrings: Definition and examples, necessary and sufficient criterion for subring, Ideals: Definition and examples, necessary and sufficient criterion for ideal, principal ideal ring, quotient ring and its operation tables.

Homomorphism: Definition and some examples, Kernel of homomorphism, Isomorphism of rings, Fundamental theorem on homomorphism, homomorphism and characteristic.

Unit III Polynomial ring:

Polynomial ring: Introduction and definition of polynomial, degree of polynomial, operation between polynomials, Integral domain $D[x]$, different types of polynomials, factorization of polynomials, Division algorithm for polynomials, irreducibility of polynomial over field, Remainder and factor theorem, solution of polynomial equation, zero of polynomial, Eisenstein's criterion for irreducibility, rational zeros of polynomial.

Unit IV Fields and Ideals:

Fields: Fields, Subfields, Extension field, The field of quotients and integral domain, Prime fields, Finite fields.

Ideals: Maximal ideals, Prime ideals and their characterization.

Text Book

- 1) Abstract Algebra - I. H. Sheth, PHI, New Delhi, Second edition-2009.

Reference Books

- 1) Topics in Algebra - I. N. Herstein, Vikas Publishing, New Delhi.
- 2) A First Course in Abstract Algebra - J. B. Fraleigh, Narosa Publishing, New Delhi.
- 3) Basic Abstract Algebra - P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Foundation Books, New Delhi.
- 4) Abstract Algebra - Dipak Chatterajee, PHI Learning Pvt. Ltd, New Delhi.

Syllabus for B Sc Semester – IV
(MATHEMATICS PRACTICAL)- Maths Major
Course-DSC-C-MAT-243P

Maths Practical (Based on MAT-241T & MAT-242T)

Practicals:

- 1) Examples of solving an operator equation.
- 2) Examples of finding Dual Basis.
- 3) Examples of inner product (applying definition of inner product)
- 4) Experiments based on orthogonalization of a basis through Gram-Schmidt orthogonalization process.
- 5) Experiments based on orthonormalization of a basis through Gram-Schmidt orthogonalization process.
- 6) Examples of Results based on orthogonal Complement.
- 7) Examples of finding value of determinant through the properties.
- 8) Examples of finding value of determinant through Laplace Expansion.
- 9) Examples of solving system of linear equations through Cramer's Rule.
- 10) Examples of finding eigen Values and eigen vectors of square matrices.
- 11) Examples of the verification of Caley-Hamilton Theorem.
- 12) Examples of matrix inversion by using Caley-Hamilton's Theorem.
- 13) Experiment based on examples of Rings, Commutative Rings, Non- commutative Rings.
- 14) Experiment based on examples of Boolean Rings and Finite Rings.
- 15) Experiment based on examples of Integral Domains and finding characteristics of Rings.
- 16) Experiment based on examples of proving or disproving Subrings.
- 17) Experiment based on examples of Left-Right Ideals, Ideals.
- 18) Experiment based on examples of Ring Homomorphisms, Finding the Kernel of Ring Homomorphism and Isomorphism of Rings.
- 19) Experiment based on factorization of polynomials, finding g.c.d. of polynomials and division of polynomials in $\mathbb{Z}_n[x]$.
- 20) Experiment based on examples of reducibility or irreducibility of polynomials..
- 21) Experiment based on examples of finding rational zeros of polynomials.
- 22) Experiment based on examples of fields, subfields, extension fields.
- 23) Experiment based on examples of Maximal Ideals, Prime Ideals,
- 24) Experiment based on examples of Finite Fields, Prime Fields and finding prime ideals and their characterization through quotient ring.