

**Syllabus Prescribed for B.Sc. First Year Examination**  
**w.e.f. 2015-16**

**Semester I**  
**1S Mathematics Paper-I**  
**(Algebra and Trigonometry)**

**Unit-I: De Moivre's theorem**, roots of complex number, circular functions, hyperbolic function, inverse hyperbolic function. Relation between circular functions and hyperbolic functions. Separation of real and imaginary parts of the circular and hyperbolic functions of complex variable.

**Unit-II: Trigonometric series:** Gregory series, Euler's series, Machin's series, Rutherford's series, summation of series, series based upon  $\sin x$ ,  $\cos x$ ,  $\sinh x$ ,  $\cosh x$ , exponential series, logarithmic series and series based upon Gregory series.

**Unit-III: Elements of quaternion:** Definition. Equality and addition, multiplication, complex conjugate of a quaternion, norm, inverse, quaternion as a rotation operator, geometric interpretation, a special quaternion product, operator algorithm, quaternion to matrices.

**Unit-IV: Theory of equations:** Relations between the roots and coefficients, transformation of equations, cubic equations (Cardon method), Descarte's rule of signs, biquadratic equations.

**Unit-V : Matrices:** Rank of a matrix, row rank, column rank, eigenvalues, eigenvectors and the characteristic equation of a matrix. Cayley-Hamilton theorem and its application.

**References Books:**

- 1] K.B.Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt.Ltd. New Delhi, 2000.
- 2] H.S.Hall and S.R.Knight, Higher Algebra, H.M.Publications, 1994.
- 3] Chandrika Prasad, Text Book on Algebra & Theory of Equations, Pothishala Private Ltd., Allahabad.
- 4] S.L.Loney, Plane Trigonometry Part-II, MacMillan & Co., London.
- 5] R.S.Verma & K.S.Shukla, Text Book on Trigonometry, Pothishala Pvt.Ltd. Allahabad.
- 6] Ayres Jr Frank : Matrices : Schaum's outline series, McGraw HillBook Company, Singapore, 1983.
- 7] T M Karade, Maya S.Bendre, Lectures on Algebra and Trigonometry.
- 8] Hohn Franz E : Elementary Matrix Algebra, Amerind Publishing Co.,Pvt.Ltd. 1964.
- 9] Spiegel M.R. :Comple Variables, Schaum's outline series, McGrawHill, 1981.
- 10] Shanti Narayan : A Test Book of Matrices, S.Chand & Co. Delhi.
- 11] Jack B Kuipers: quaternion algebra of Quaternions and rotation sequences, Princeton University Press, Fifth printing, 2002.

**Semester I**  
**1S Mathematics Paper-II**  
**(Differential and Integral Calculus)**

**Unit-I:** Definition of the limit of a function, basic properties of limits, continuous functions and classification of discontinuities.

**Unit-II :** Differentiability, successive differentiation, Leibnitz theorem, indeterminate forms and L'Hospital rule.

**Unit-III:** Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Maclaurin and Taylor series expansions.

**Unit-IV:** Partial derivatives and differentiation of real valued function of two variables, homogeneous functions, Euler's theorem on homogeneous functions.

**Unit-V:** Integration of the form  $\int \frac{P_n(x)}{\sqrt{Q}} dx$ , reduction formulae for  $\int \sin^n x dx$ ,  $\int \cos^n x dx$  and

Walli's formula,  $\int \tan^n x dx$ ,  $\int \cot^n x dx$ ,  $\int \sec^n x dx$ ,  $\int \csc^n x dx$ ,  $\int \sin^n x \cdot \cos^m x dx$ , quadrature, rectification,

**References :**

- 1] Ayres F Jr. : Differential equations, Schaum's outline series, McGraw Hill, 1981.
- 2] Ayres F.Jr. : Calculus, Schaum's Outline series, McGraw Hill, 1981.
- 3] Karade T.M., J.N.Salunke, M.S.Bendre : Graduate level Calculus, Sonu-Nilu, 5, Bandu Soni layout, Gayatri Road Parsodi, Nagpur.
- 4] Karade T.M., Maya S.Bendre : Integration and Differential equations, Sonu-Nilu, 5, Bandu Soni layout, Gayatri Road Parsodi, Nagpur.
- 5] Edwards J : Differential Calculus for Beginners, MacMillan and Co.Ltd., 1963.
- 6] Edwards J : Integral Calculus for Beginners, AITBS, Publishers and Distributors, 1994.
- 7] Forsyth A.R.: A Treatise on Differential Equations, (Sixth Edition) MacMillan and Co. 1956.
- 8] Greenspan D. : Introduction to Calculus, Harper and Row, 1968.
- 9] Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
- 10] Gorakh Prasad : Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
- 11] Erwin, Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, 1999.
- 12] N.Piskunov : Differential and Integral Calculus, Peace Publishers, Moscow.

## Syllabus Prescribed for the year 2023-24, UG Program

Program: B.Sc. II (Mathematics)

Semester- III

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods/week)
DSC-V / Mathematics	Advanced Calculus	9+1* (Including both the papers of Sem-III)

Cos: After completing this course, students would be able to

1. get knowledge of basic principles of limit and continuity, Taylor's theorem.
2. understand Lagrange's multipliers method and Jacobian.
3. understand the concept of improper integral and Beta-Gamma function.
4. learn the definition of sequence and series and Sandwich theorem.
5. learn various tests for convergence and divergence of series.

Unit	Content
Unit I	<b>Limit and Continuity:</b> Limit and Continuity of functions of two variables, Algebra of Limit and Continuity, Taylor's theorem of function of two variables. (12 period)
Unit II	Maxima and Minima of two variables, Lagrange's multipliers method, Jacobian: (12 period)
Unit III	Improper Integral (Definition only), Beta and Gamma functions, Properties of Beta and Gamma functions, Relation between Beta and Gamma functions. (12 period)
Unit IV	<b>Sequence:-</b> Definition of Sequence, Uniqueness of limit of sequence, Algebra of limit of a sequence, Positivity theorem, Sandwich theorem, Monotonic and Bounded sequence (Definition only), Cauchy Sequence. (12 period)
Unit V	<b>Series:</b> Series of non-negative terms, Convergence of geometric series, P-Series, Comparison test, Cauchy's integral test, Ratio test, Root test (12 period)
<b>*SEM</b>	
COs: 1. To enhance interest among the students about course. 2. To develop the learning and writing skills. 3. To create mental ability.	
<b>**Activities</b>	1. Unit Test 2. Seminar/Group Discussion 3. Quiz/ Study Tour/Project/Assignments/Open Book Test

\* For the subject Mathematics, the strength of a batch of tutorials for UG classes shall be 16 (Sixteen) with an addition of 10 percent with the permission of Honorable Vice Chancellor (As amended by Executive Council dated 27/28-4-1979)

Text book :

↓ V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapekar, A. N. Rangari, Y. S. Solanke: A Text Book of Advanced Calculus, Dnyanpath publication, Amravati, First edition 2023.

Reference Books:

- 1] T. M. Karade, J. N. Salunke, Maya S. Bendre, D. T. Solanke, C. S. Khodre, S. P. Gaikwad, N. B. Nawale: Advanced Calculus, SONU-NILU, Nagpur, 2023
- 2] Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
- 3] Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
- 4] Murray R. Spiegel: Theory and Problems of Advanced Calculus, Schaum Outline Series.
- 5] S. C. Malik and Arora: Mathematical Analysis, Wiley Eastern Ltd., New Delhi.
- 6] O. E. Stanaitis : An Introduction to Sequences, Series and improper Integrals, Holden-Dey, Inc. San Francisco, California.
- 7] Earl D. Rainville : Infinite series, The Macmillan Co., New York.
- 8] N. Piskunov : Differential and Integral Calculus, Peace publishers, Moscow.
- 9] Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
- 10] D. Somasundaram and B. Choudhary: A First course in Mathematical Analysis, Narosa Publ. House.

Program: B.Sc.-II (Semester-III), Mathematics

Syllabus Prescribed for the Year 2023-24, UG Program

Program: B.Sc.-II

Semester- III

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods/week)
DSC-VI / Mathematics	Partial Differential Equations	9+1*(Including both the papers of Sem-III)

**Cos:** After completing this course, students would be able to

1. study partial derivatives, differential equation, real valued functions of two variables and solve the system of homogeneous functions.
2. learn to evaluate partial differential equations, solution of some special type of equations
3. learn to solve methods of partial differential equation of second and higher order.
4. students will be familiar with techniques of Calculus of variations.
5. recognize various methods of separation of variables.

Unit	Content
Unit I	Partial Derivatives and Differentiations of real valued functions of two variables, Homogeneous function, Euler's theorems on homogeneous function. (12 period)
Unit II	Formation of PDE, Partial Differential equation of the first order, Total Differential equation (Pfaffian), Lagrange's method, Some special type of equations. (12 period)
Unit III	Compatible Differential equation, Charpit's general method of solutions, Partial Differential equation of second and higher order, Homogeneous and non-homogenous equation with constant coefficients. (12 period)
Unit IV	Calculus of Variation: Functional, Continuity of functional, variational problems with fixed boundaries, Extremum of a functional. (12 period)
Unit V	Method of Separation of variables, Method of separation of variables for wave equations and heat equations in one dimension. (13 period)

<b>*SEM</b>	
COs: 1.To enhances interest among the students about course. 2. To develop the learning and writing skills. 3. 3. To create mental ability.	
<b>**Activities</b>	1. Unit Test 2. Seminar/Group Discussion 3. Quiz/ Study Tour/Project/Assignments/Open Book Test

\* For the subject Mathematics, the strength of a batch of tutorials for UG classes shall be 16 (Sixteen) with an addition of 10 percent with the permission of Honorable Vice Chancellor (As amended by Executive Council dated 27/28-4-1979)

**Text Books:**

- ✚ V. A. Sharma, S. R. Bhojar, V. R. Patil, G. U. Khapekar, S. R. Kumbhare, T. D. Nakade, Salim H. Shaikh: A Text Book of Partial Differential Equation, Dnyanpath publication, Amravati, First edition 2023.

**Reference Books:**

- 1] T. M. Karade, J. N. Salunke, Smita V. Nahatkar, S. N. Bayaskar, I. D. Pawade, S. A. Salve, A. F. Gotharkar : Partial Differential Equations, SONU-NILU, Nagpur, 2023
- 2] Murray D.A.: Introductory course in Differential Equations, Orient Longman (India), 1967.
- 3] Erwin, Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 1999.
- 4] Piaggio HTS: Differential Equations, CBS Publishers & Distributors, Delhi, 1985.
- 5] Siminons G.F. : Differential Equations, Tata McGraw Hill, 1972.
- 6] A.R. Forsyth. A Treatise on Differential Equations. Macmillan and Co. Ltd. London.
- 7] Ian N., Sneddon, Elements of Partial Differential Equations. McGraw-Hill Book Company, 1988.
- 8] Jane Cronin. Differential equations, Marcel Dekker, 1994.
- 9] Fmk Ayres. Theory and Problems of Differential Equations. McGraw Hill Book Company, 1972.
- 10] Richard Bronson, Theory and Problems of Differential Equations, McGraw Hill Inc, 1973.
- 11] A. S. Gupta: Calculus of Variations with Applications, Prentice-Hall of India, 1997.
- 12] I. M. Gelfand and S. V. Fomin: Calculus of Variations, Prentice-Hill Englewood Cliffs (New Jersey), 1963.
- 13] A. S. Gupta: Calculus of Variations with Applications, Prentice-Hall of India, 1997.
- 14] I. M. Gelfand and S. V. Fomin: Calculus of Variations, Prentice-Hill Englewood Cliffs (New Jersey), 1963.

**Program: B.Sc.- II (Semester- IV), Mathematics**

**Syllabus Prescribed for the year 2023-24, UG Program**

**Program: B.Sc.-II**

**Semester IV**

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods/week)
DSC-VII / Mathematics	Elements of Algebra	9+1* (Including both the papers of Sem-IV)

**COs:** After completing this course, students would be able to

1. learn the concept of Group, Subgroup and Cosets.
2. explain the significance of the notations of Cosets, Normal subgroups and Quotient group.
3. learn the concept of Homomorphism & Isomorphism and its Theorem.
4. study the properties of Ring and Ideals and Integral domain.
5. familiar with Fundamental concepts of Number theory.

Unit	Content
Unit I	Group: Definition of a group with examples, Properties of group, Subgroup, Cyclic group, Order of a generator of a cyclic group, Permutation groups, Even and Odd permutations. (12 period)
Unit II	Cosets and Normal subgroups: Cosets, Lagrange's theorem, Normal subgroups, Different Characterization of normal subgroups, Quotient group. (12 period)
Unit III	Homomorphism and Isomorphism: Homomorphism, Homomorphic image, Kernel of Homomorphism, Isomorphism of a group, Fundamental theorem on homomorphism of a group, second isomorphism theorem, third Isomorphism theorem. (12 period)
Unit IV	Ring: Definition, Examples and Properties of a ring (Commutative ring, ring with unity, zero divisor, without zero divisor), Subring, Characterization of ring, Integral domain, field, subfield, prime field(Definition Only). (14 period)
Unit V	Fundamental Concept of Number theory: Well ordering Principle, Principle of Mathematical induction, Division Algorithm, Greatest common divisor, Least common multiple, Euclidean Algorithm, Prime, fundamental theorem of arithmetic, Congruence and its properties. (15 period)
<b>*SEM</b>	
COs: 1.To enhances interest among the students about course. 2. To develop the learning and writing skills. 3. To create mental ability.	
<b>**Activities</b>	1.Unit Test 2. Seminar/Group Discussion 3. Quiz/ Study Tour/Project/Assignments/Open Book Test

\* For the subject Mathematics, the strength of a batch of tutorials for UG classes shall be 16 (Sixteen) with an addition of 10 percent with the permission of Honorable Vice Chancellor (As amended by Executive Council dated 27/28-4-1979)

#### Text book :

↓ V. A. Sharma , S. R. Bhoyar, V. R. Patil, G. U. Khapekar , A. N. Rangari, N. S. Bayaskar, R. V. Kene, P. B. Deshmukh, M. C. Dhabe: A Text Book of Elements Algebra, Dnyanpath publication, Amravati, First edition 2023

#### Reference Books:

- 1] T. M. Karade, J. N. Salunke , Smita V. Nahatkar, Rekha Rani, Vidya N. Mahalle, K. M. Patil, V. D. Bokey, S. M. Munde: Elements of Algebra, SONU-NILU, Nagpur, 2023
- 2] I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
- 3] N. Jacobson : Basic Algebra , Vol. I and II W. H. Freeman, 1980 (Hindustan Publishing Co.
- 4] Shanti Narayan : A Text Book Of Modern Abstract Algebra, S. Chand and Co. , New Delhi
- 5] K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000
- 6] P. B. Bhattacharya, S. K. Jain and S. R. Nagpal : Basic Abstract Algebra (IInd Edition) Cambridge University Press Indian Edition, 1997
- 7] K. Hoffman and R. Kunze : Linear Algebra , II nd Edition Prentice Hall, Englewood Cliffs, New Jersey, 1971.
- 8] S. K. Jain, A. Gunawardhana and P. B. Bhattacharya : Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag) 2001
- 9] S. Kumaresan : Linear Algebra, A Geometric Approach, P Prentice Hall of India Pvt. Ltd. New Delhi, 2000
- 10] Vivek Sahai and Vikas Bisht: Algebra, Narosa Publishing House, 1997.
- 11] D. S. Malik, J. N. Mordeson and M. K. Sen: Fundamentals of Abstract Algebra, McGraw Hill International Edition 1997
- 12] D. M. Burton: Elementary Number Theory, Universal Book Stall, New Delhi, Second Edition 2003.
- 13] C. Y. Hsiung: Elementary Theory of Numbers, Allied Publishers Ltd. 1992.
- 14] I. Niven, H. S. Zuckerman and H. L. Montgomery: An introduction to the Theory of Numbers, Wiley Student Edition, Fifth edition 2004.
- 15] K. H. Rosen: Elementary Number Theory and its Applications, Addison-Wesley, 1986.
- 16] T. M. Karade, J. N. Salunke, K. D. Thengane, M. S. Bendre: Lectures on Elementary Number Theory, Sonu-Nilu publication 2005.
- 17] K. Ireland and M. Rosen: A Classical Introduction to Modern Number Theory, GTM Volume 84, Springer-Verlag 1972
- 18] G. A. Jones and I. M. Jones: Elementary Number Theory, Springer, 1998

**Program: B.Sc.- II ( Semester-IV), Mathematics**

**Syllabus Prescribed for the year 2023-24 , UG Program**

**Program: B.Sc.-II Semester- IV**

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods/week)
DSC –VIII / Mathematics	Classical Mechanics	9+1* (Including both the papers of Sem-iv)

#### COs:

After completing this course, students would be able to  
1. learn radial and transverse component of velocities and acceleration.

2. learn to explain Degree of freedom, Generalized co-ordinates and constraints.
3. learn to expressing the central force motion and areal velocity.
4. explain the significance of coplanar forces, triangle law of forces, parallel forces and equilibrium forces.
5. learn to find work and energy, virtual work and uniform catenary.

Unit	content
Unit I	Velocities and Acceleration along the co-ordinate axes, Radial and Transverse directions, Tangential and Normal directions, Projectiles. (12 period)
Unit II	Degree of freedom, Constraints, Generalized Co-ordinates, D'Alembert Principles and Lagrange's equations of motions. (12 period)
Unit III	Central force motion, Areal velocity, Equivalent one body problem, Central orbit, Virial theorem, Kepler's laws of motion (statement only). (12 period)
Unit IV	Coplanar forces, forces acting at a point, triangle law of forces, Parallel forces, Equilibrium Forces, Lami's Theorem, Analytical condition of equilibrium of Coplanar forces. (13 period)
Unit V	Work and Energy, virtual work, Uniform Catenary. (12 period)
<b>*SEM</b>	
COs: 1.To enhances interest among the students about course. 2. To develop the learning and writing skills 3. To create mental ability.	
<b>**Activities</b>	1. Unit Test 2.Seminar/Group Discussion 3.Quiz/ Study Tour/Project/Assignments/Open Book Test

\* For the subject Mathematics, the strength of a batch of tutorials for UG classes shall be 16 (Sixteen) with an addition of 10 percent with the permission of Honorable Vice Chancellor (As amended by Executive Council dated 27/28-4-1979)

**Text book:**

- ↓ V. A. Sharma, V. R. Patil, S. R. Bhoyar, G. U. Khapecar, A.P.Wasnik, P. R. Langade, Y. D. Naner A. M. Bagde, N. B. Nawale, M. D. Netnaskar: A Text Book of Classical Mechanics, Dnyanpath publication, Amravati, First edition 2023.

**Reference Books:**

- 1] T.M.Karade, J.N.Salunke, Smita V. Nahatkar, Y.D.Patil, Minakshi T. Sarode, S.B. Khobragade, A.M.Bagade: Elements of Classical Mechanics, SONU-NILU, Nagpur, 2023.
- 2] H. Goldstein: Classical Mechanics (2nd edition) Narosa publishing house, New Delhi, 1998.
- 3] D. A. Wells: Lagrangian Dynamics, McGraw Hill, 1967.
- 4] J. L. Synge, B.A. Griffith: Principles of Mechanics, McGraw Hill, 1959.
- 5] M. R. Spiegel: Theoretical Mechanics, McGraw Hill, 1983.
- 6] L.D. Landau, E. M. Lifschitz: Mechanics, Pergamon Press, 1976.
- 7] B. R. Gossick: Hamilton's Principle and Physical Systems, Academic Press, 1967.
- 8] S. L. Loney : An Elementary Treatise on the Dynamics of a particle and of rigid bodies, Cambridge University Press, 1956.
- 9] P. K. Mittal: Mathematics for Degree Students, S. Chand & Co Ltd, New Delhi, 2011.

**Semester V**  
**5S Mathematics Paper –X**  
**( Mathematical Methods )**

**Unit-I:** Legendre's equation, Legendre's polynomials, generating function of  $P_n(x)$ , recurrence formulae for  $P_n(x)$ , orthogonality of Legendre's polynomial, Rodrigue's formula.

**Unit-II:** Bessel's equation, solution of Bessel's equation, generating function for  $J_n(x)$ , Recurrence formulae for  $J_n(x)$ . Strun-Liouville boundary value problem.

**Unit-III:** Fourier series, Fourier series for odd and even functions, half-range Fourier sine series and half-range Fourier cosine series.

**Unit-IV:** Laplace transform: Laplace transform of some elementary functions, existence of Laplace transform. properties of Laplace transform. Laplace transform of derivatives and integrals, multiplications of  $t^n$  and division by  $t$ , inverse Laplace transform, convolution property, application of Laplace transform in solving ordinary and partial differential equations.

**Unit-V:** Fourier Transform: Finite Fourier sine transform, inverse finite Fourier sine transform and cosine transform, Infinite Fourier transform, infinite Fourier sine transform and cosine transform, properties of Fourier transform, application to partial differential equations.

**Reference Books :**

- 1) Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.
- 2) A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd. , London.
- 3) Frank Ayres : Theory and Problems of Differential Equations. McGraw Hill Book Company, 1972.
- 4) B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
- 5) T. M. Karade : Lectures on Differential Equations, Sonu-Nilu Publication, Nagpur.
- 6) I. N. Sneddon : Fourier Transforms, McGraw Hill Book Co.
- 7) Goel and Gupta : Integral Transforms, Pragati Prakashan , Meerut.
- 8) Raisinghaniya, M.D., Integral Transform, S.Chand & Co., N.D.

**Semester VI**  
**6S Mathematics Paper -XI**  
**(Linear Algebra )**

**Unit I : Vector Space :** Definition and example of vector spaces, subspaces, sum and direct sum of subspaces, linear span, linear dependence, independence and their basic properties, basis , finite dimensional vector spaces ,existence theorem for bases, invariance of the number of elements of a basis set, dimension.

**Unit II: Linear transformations:** Linear transformation and their representation as matrices, algebra of linear transformations, rank nullity theorem, change of basis.

**Unit III : Dual Spaces:** Dual space, bidual space and natural isomorphism, adjoint of a linear transformation, Eigen values and eigenvectors of a linear transformation.

**Unit IV : Inner Product Spaces:** Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors, orthogonal complements, orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram Schmidt orthogonalisation process.

**Unit V: Modules:** Modules, submodules, quotient modules, homomorphism and isomorphism theorems.

**Reference Books:**

1. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. N. Jacobson: Basic Algebra , Vol. I and II W.H. Freeman, 1980 (Hindustan Publishing Co.)
3. Shanti Narayan : A Text Book Of Modern Abstract Algebra, S. Chand and Co. , New Delhi
4. K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000
5. P.B. Bhattacharya, S. K. Jain and S. R. Nagpal : Basic Abstract Algebra (IIInd Edition) Cambridge University Press Indian Edition, 1997
6. K. Hoffman and R. Kunze: Linear Algebra , IIInd Edition Prentice Hall, Englewood Cliffs, New Jersey, 1971.
7. S. K. Jain, A Gunawardhana and P. B. Bhattacharya: Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
8. S. Kumaresan : Linear Algebra, A Geometric Approach P Prentice Hall of India Pvt. Ltd. New Delhi, 2000 .
9. Vivek Sahai and Vikas Bisht : Algebra, Narosa Publishing House , 1997.
10. D. S. Malik, J. N. Mordeson and M. K. Sen : Fundamentals of Abstract Algebra , McGraw Hill International Edition 1997 .
11. T. M. Karade, J.N. Salunke, K. S. Adhav, M. S. Bendre : Lectures on Abstract Algebra. Sonu Nilu Publication. Nagpur (IIInd Publication).
12. John B. Fraleigh : A First course in Abstract Algebra.
13. Joseph A. Gallian: Contemporary Abstract Algebra, Narosa publishing house.
14. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: First Course in Linear Algebra.
15. V. Krishnamurthy , V. P. Mainru, J.L. Arora: An Introduction to linear Algebra.
16. L Smith: Linear Algebra, Springer-Verlag New York.

**Semester VI**  
**6 S - Paper-XII (Optional)**  
**( Graph Theory )**

**Unit I :** Graph. Application of graphs, finite and infinite graphs, incidence and degree, isolated vertex, pendent vertex and null graph, isomorphism, subgraphs, walks, path and circuits, connected graphs and components, Euler graph, operation on graphs, Hamiltonian paths and circuits, travelling sales man problem.

**Unit II :** Trees, some properties of trees, pendent vertices in a tree, distance and centres in a tree, Rooted and binary trees, On counting trees, spanning trees.

**Unit III :** Fundamental circuits, Cutsets, Some properties of cutesets, all cuteset in a graph, fundamental circuits and cutsets, connectivity and separability, planer graphs, Kuratowski's two graphs, different representation of planer graph, detection of planarity.

**Unit IV :** Vector space associated with a graph, circuit and cuteset subspaces, Orthogonal vectors and spaces, Intersection and join of  $W_r$  and  $W_s$ .

**Unit V :** Incidence matrix, Submatrix of  $A(G)$ , Circuit matrix, Fundamental circuit matrix  $B$ , Rank of  $B$ , an application to a switching network, cuteset matrix, path matrix, adjacency matrix, the relationship among  $A_r$ ,  $A_s$  and  $C_r$ .

**Reference Books:**

1. Narsingh Deo: Graph Theory with Application to Engineering and Computer Science, Prentice Hall Of India, New Delhi.,
2. Richard Johnson- Baugh : Discrete Mathematics, Macmillan Publishing Company 886, Third Avenue New York 10022
3. Olympia Nicodemi : Discrete Mathematics, C.B.S. Publ. and Distributors 485, Jain Bhavan Bholanath Nagar Shahadara New Delhi-32 India
4. Frank Harare : Graph Theory, Narosa Publishing House, 307, Shiv Centre D.B.C. Sector Ku Bazar New Bombay 400704,
5. S.A. Choudum: A first Course In Graph Theory, McMillan India Ltd. Mercatile House Magazine Street Bombay 10
6. E.L. Liu : Elements of Discrete Mathematics, McGraw Hill Book Company, New York
7. Seymour Lipschitz and Marc Lipson : Discrete Mathematics, TMH New Delhi (Schaum Outline series) II<sup>nd</sup> Edition.
8. J.N. Salunke : Boolean Algebra and Graph Theory Laxmi Publication Akot.