

**St. Xavier's College (Autonomous), Ahmedabad-9**  
**BSc. Mathematics**

**Semester I**

**CORE Paper: Matrix Algebra and Co-ordinate Geometry (Theory)**

**Course Code: MT 1501**

**No. of Credits: 04**

**Learning Hours: 60 hrs**

**Unit: I**

Introduction to matrices, different types of matrices, operations on matrices, Theorems on matrices, Elementary operations on matrices and types of matrices, Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, orthogonal matrices, unitary matrices, normal matrices, Elementary Matrices. Linear dependence and independence of row and column matrices, Row rank, column rank and rank of a matrix, Row Reduced Echelon (RRE) form of a matrix and matrix inversion using it.

**Unit: II**

Eigen values, Eigen vectors and the characteristic equation of a matrix. Cayley-Hamilton (CH) theorem and its use in finding inverse of a matrix, Application of matrices in solving a system of simultaneous linear equations, Cramer's rule, Theorems on consistency of a system of simultaneous linear equations.

**Unit-III: Sphere and Introduction to conicoid:**

Definition of a sphere in  $\mathbb{R}^3$ , Cartesian equation of a sphere, General equation of a sphere, Equation of a sphere with diametrically opposite end points, Intersection of a sphere with Line/plane/sphere( No theory but only problems), Equation of a tangent plane to a sphere. The tangency of a plane and normality of a line to a sphere, Orthogonal spheres.

Conicoids: Introduction to conicoid, types of central and non central conicoids in  $\mathbb{R}^3$ , figures of conicoids.

**Unit IV: Various coordinate systems and Cone and cylinder in  $\mathbb{R}^3$  :**

Polar coordinates in  $\mathbb{R}^2$  &  $\mathbb{R}^3$  and its Relationships with Cartesian coordinates, polar equation of line/circle/conic and properties of conics. Spherical, Cylindrical, Conical coordinates in  $\mathbb{R}^3$ .

Introduction to different types of cone and cylinder, Equations of enveloping cone/cylinder, Right circular cone/cylinder (without proof), Problems on cone and cylinder.

**Reference Books:**

1. H. Anton, Elementary linear algebra with applications (8th Edition), John Wiley (1995).
2. Linear Algebra Theory and Applications – Ward Cheney, David Kincaid. Jones and Bartlet India Pvt. Ltd.
3. Introduction to Linear Algebra – Serge Lang. Springer (India).

4. Gilbert Strang, Linear Algebra and its Applications (English) 4<sup>th</sup> edition, Academic press, Indian edition.
5. Matrix and Linear Algebra – K. B. Dutta, Prentice Hall.
6. A Textbook of Matrices – Shanti Narayan, P K Mittal, S. Chand Group.
7. Analytical Solid Geometry- Shanti Narayan
8. Co-ordinate Geometry By : R.J.T. Bell.
9. Solid Geometry( three dimension) – H. K. Das ,S. C. Saxena and Raisinghania , S. Chand
10. Coordinate Geometry, Polar Coordinate approach, M MTripathi, Alpha Science International

### **Practicals: Matrix Algebra and Co-ordinate Geometry**

**Course Code: MT 1502L**

**No. of Credits: 03**

**Learning Hours: 60 hrs**

#### **List of practicals (problems) on:**

1. Matrix algebra.
2. Different methods of finding Inverse of a matrix.
3. RRE form and rank of a matrix.
4. Solution of system of linear equations using row operations and Cramer's rule.
5. Linearly independent and dependent vectors.
6. The Cayley-Hamilton theorem and its applications
7. Eigen values and eigen vectors of matrices.
8. Various coordinate systems in  $R^2$  and polar equation of line.
9. Various coordinate systems in  $R^3$ . Transformation equations from one system to another system.
10. Polar equations of Circle.
11. Polar equations of Conic.
12. Sphere-I.
13. Sphere-II.
14. Cone.
15. Cylinder.
16. Project on Identification of curves/surfaces

## Semester II

### CORE Paper: Calculus and Differential Equations (Theory)

Course Code: MT 2501

No. of Credits: 04

Learning Hours: 60 hrs

**Prerequisites (not to be asked but must be done):** Introduction of Differential equations, its order and degree. Family of curves leading to differential equation and its solution in family of curves, Different types of solutions (viz. General, Particular and Singular solutions). Constant of integration, Boundary/initial conditions, Differential equations of first order and first degree.

#### Unit I:

- a) Successive Differentiation: Introduction to successive derivatives, nth derivatives of some standard functions, Leibnitz theorem
- b) Mean Value theorems: Rolle's mean value theorem, Lagrange's mean value theorem, Different forms of LMVT, Cauchy's mean value theorem, Applications of MVTs.

#### Unit II:

- a) Convergence and divergence of infinite series: Definition of series, Convergent and divergent series of real numbers, sum of series, different test of convergence of infinite series-convergence of geometric series, comparison test, practical comparison test, D'Alembert ratio test, Cauchy's root test, alternating series, power series.
- b) Taylor's and Maclaurin's Theorems (without proof), Expansions of some standard functions as infinite power series without validity of the expansions.

#### Unit III:

- a) Methods of solving differential equations of first order and degree one: Variable separable, Homogeneous and non-homogeneous differential equations, exact differential equations (without proof), Integrating factors, linear differential equation, Bernoulli's differential equation and Differential Equations reducible to them.
- b) Method of solving differential equations of first order and higher degree solvable for  $y$ , solvable for  $x$ , solvable for  $p$  ( where  $p = \frac{dy}{dx}$  ), Clairaut's differential equation, Lagrange's differential equation.

#### Unit IV:

- a) Linear differential equations of higher order and degree one: Differential operators. Linear differential equations of higher order and degree one with constant coefficients, Complementary and particular integrals. Inverse operator, operational methods for its solutions, Euler form of homogeneous linear differential equations with variable coefficients.

#### Reference Books

- 1 Differential Calculus, Shanti Narayan, S. K. Mittal, S. Chand and Co. Publication.
- 2 Anton, Biven and Davis, Calculus, 10<sup>th</sup> edition, Willey Publication.
- 3 Thomas, Calculus early transcendental, Addison-Wesley person publication.
- 4 Integral calculus, Shanti Narayan, S. Chand Limited, 2005.
- 5 Elementary Differential Equations, Rainville and Bedient, Macmillan Publication.

- 6 Ordinary and Partial Differential Equations, M. D. Raisingania, S. Chand and Company, 2009.
- 7 Differential Equations- D.A. Murray, Tata McGraw Hills.
- 8 Ordinary Differential Equations and Partial Differential Equations, Nita shah, PHI Ltd.
- 9 Theory and problems on Differential Equations- Frank Ayres, McGraw Hill Book Co., New York.

## **Semester II (Mathematics)**

### **MT 2502L: Calculus and Differential Equations (Practical)**

**No. of Credits: 03**

**Learning Hours: 60 hrs**

#### **List of practical (problems) on:**

1. Graphs of some Cartesian curves  $\mathbb{R}^2$ . ( Trigonometric function, conic, polynomial)
2. Graphs of some parametric and polar curves in  $\mathbb{R}^2$ . (Cycloid, conic, asteroid, cardioids)
3. Discuss concavity and point of inflexion of the curve in  $\mathbb{R}^2$ .
4. To find asymptotes of curves including Cauchy's method.
5. Method of Integration: Partial fraction, Limit of sum using definite integral, substitution
6. Method, Integration by parts.
7. Reduction formulae only for definite integrals.
8. Application of Integration-I (Arc length and Area)
9. Application of Integration-II (Volume and surface Area)
10. Application of Leibniz theorem.
11. Discuss convergence of the infinite series.
12. Problem on Mean value theorem
13. Expansion of function in infinite power series using Taylor's and Maclaurin's formula
14. Evaluate limits using L'Hospital's Rule
15. The differential equations of order 1 and degree 1.
16. The differential equations of order 1 and higher degree.
17. The differential equations of higher order and degree 1.

**Elective:****Mathematical basics and Quantitative skills****Course Code: MT 1301****No. of Credits: 02****Learning Hours: 30 hrs**

**Objective: This course is designed for those students who did not opt Mathematics in 12<sup>th</sup> Standard but wanted to take Physics or Electronics as a major subject at T. Y. B. Sc..**

**Unit 1. Trigonometry:**

Unit circle, trigonometric functions, values of trigonometric function at distinct points, relation among trigonometric functions, trigonometric formulae,  $\sin x \pm y$ ,  $\cos x \pm y$ ,  $\tan x \pm y$ ,  $\operatorname{cosec} \pm \operatorname{cosec}$ ,  $\operatorname{cosec} \pm \operatorname{cosec}$ ,  $2\sin x \cos y$  (and others) and inverse of trigonometric functions.

**Unit 2. Determinant, Co-ordinate Geometry and Vectors:**

Determinant its expansion. Elementary properties, Solution of linear Equation using Determinant. Distance Formula, Section Formula, Equation of a line and its slope, intersection of two lines, Equation of a circle and its tangent, elementary vector algebra.

**Unit-3. Limit and Differentiation:**

Right hand limit, Left hand limit and limit of a function.  $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$ ,  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ ,  $\lim_{x \rightarrow a} \frac{a^h - 1}{h}$  and  $\lim_{n \rightarrow \infty} (1 + \frac{1}{n})^n$  continuity, derivatives of  $x^n$ ,  $e^x$ ,  $\log x$ , trigonometric functions, inverse trigonometric functions, chain rule, geometric meaning of derivative.

**Unit-4. Integration:**

Integration of  $x^n, e^x$ , trigonometric functions, well known functions like  $\frac{1}{x^2 \pm a^2}$ ,  $\frac{1}{\sqrt{x^2 \pm a^2}}$ ,  $\sqrt{x^2 \pm a^2}$ , Method of substitution, integration by parts, definite integral (Up to Fundamental Theorem of Integral Calculus).

- **Note:** All the results / formulae are without proof.

1. Gujarat Rajya Pathya Pustak Mandal for standards 11 and 12.
2. A Textbook for class XI & XII, National Council of Educational Research and Training.
3. A Class Book of Mathematics for class XII by Chakrabarty S. K., Biswajit Bhagwati, S. Chand Publishers.

**Semester II**  
**Elective**  
**Course Code: MT 2301**  
**No. of Credits: 02**  
**Learning Hours: 30 hrs**

**Syllabus for Semester I (Mathematics- Elective)**  
**MAT ELECTIVE: Matrix Algebra through SCILAB (Practical)**

**Unit-I**

Introduction to SCILAB, SCILAB environment, Workspace and working directory, Some elementary programming.

**Unit-II**

Creating matrices, some simple matrix operations.

**Unit-III**

Some advanced matrix algebra through SCILAB.

**Unit-IV**

Practical Based on the Unit-I, Unit-II, Unit-III

- 1 To input row vectors, column vectors, square and rectangular matrices.
- 2 To obtain addition, subtraction and multiplication, division of matrices and multiplication of matrix with scalar.
- 3 To obtain sub matrices of given matrix and to delete rows and columns.
- 4 To find minors, cofactors and adjoint of a matrix.
- 5 To find inverse of the matrix using adjoint of a matrix.
- 6 To learn commands zeros, ones, eye, rand, det(), inv(), command for transpose.
- 7 To find the inverse of a matrix using GAUSS-ELIMINATION method..
- 8 To find inverse of given matrix using GAUSS-JORDAN method
- 9 To find Eigen values and Eigen vectors of given matrix
- 10 To find inverse of given matrix using CAYLEY-HAMILTON theorem

**Reference Books:**

- 1 An Introduction to Scilab-Satish Annigeri, December 2009
- 2 Scilab for very beginners-Scilab enterprises

## Semester III (Mathematics)

Course Code: MT 3501

Advanced Calculus-I (Theory)

No. of Credits: 04

Learning Hours: 60 hrs

### Unit 1: Limit-Continuity of function of several variables and partial derivatives:

Introduction to function of several variables, rectangular and spherical neighbourhood of a point in  $R^n$ , Limit of function of several variables, concept of iterated limits, limit and path, continuity of function of several variables.

### Unit 2: Differentiability of function of several variables-I

Directional derivatives, Introduction to partial derivatives and their geometric interpretation, higher order partial derivatives and problems. Differentiability of function of two variables, theorems on differentiability conditions and their converses, Schwartz's theorem and Young's theorem on mixed partial derivatives.

### Unit 3: Differentiability of function of several variables-II

Differential of function of two variables, Chain rules for differentiability, derivatives of implicit functions. Homogeneous functions, Euler's theorem for homogeneous functions of n-variables, Extreme values of functions of two variables and its converse, Lagrange's method of undetermined multipliers (only problems to be asked).

### Unit 4: Applications of partial derivatives

Taylor's Theorem for function of two variables (proof of two variables only), Maclaurin's theorem, problems on Taylor and Maclaurin theorems, multiple points, different types of double points and examples, radius of curvature for Cartesian-parametric-polar equations of a curve in  $R^2$ , Application to geometry.

### Reference Books:

1. Mathematical Analysis – S. C. Malik and Savita Arora, Second Edition, New Age Int. (P) Ltd.
2. Differential Calculus – Shanti Narayan.
3. Calculus - David V. Widder- PHI-second edition.
4. Calculus & Analytic Geometry - G. B. Thomas & R. L. Finney Addison- Wesley pub. India.
5. Calculus with Early Transcendental functions - James Stewart, Indian Edition, Engage Learning India Pvt Ltd.
6. Advanced Calculus Volume I &II – T. M. Apostol.
7. Anton, Howard, Stephen Davis, and IrlBivens. Calculus: a new horizon. New York: Wiley, 1999.
8. The calculus with analytic geometry, Louis Leithold , Harper & Row, 5th edition, 1986

## Semester III (Mathematics)

Course Code: MT 3502

Linear Algebra-I (Theory)

No. of Credits: 04

Learning Hours: 60 hrs

**Prerequisites:** Relation, Equivalence Relation, Binary Operation.

### Unit 1:

Vector space: Definition, Examples, Properties, Subspaces, Span of a Set, operations of Subspaces, sum and direct sum of Subspaces, Linear Variety.

### Unit 2:

Finite linear combination, linear dependence/independence, basis and dimension of a vector space, dimension Theorem.

### Unit 3:

Linear Transformations, Range and Kernel of a Linear Map, Rank and Nullity of a Linear Map, Rank – Nullity Theorem, Inverse of a Linear Map, Consequences of Rank – Nullity Theorem, Isomorphism, Operation equation.

### Unit 4:

Matrix associated with a Linear Map, Linear Map associated with a Matrix, Linear operations in  $\mu_{m,n}$ , dimension Theorems for  $\mu_{m,n}$  and  $L(U,V)$ . Rank – Nullity of Matrices and verification of the Rank-Nullity Theorem for Matrices.

### Text Book:

An Introduction to Linear Algebra – V. Krishnamurthy & others. (Affiliated East-West press, New Delhi)

### Reference Books:

1. Linear Algebra a Geometric Approach - S. Kumaresan, PHI.
2. Linear Algebra with Applications – Otto Bretscher– 3<sup>rd</sup> ed. –Pearson Education.
3. An Introduction to Linear Algebra – I. K. Rana, Ane Books Pvt. Ltd., New Delhi.
4. Matrix and Linear Algebra – K. B. Datta, Prentice Hall, New Delhi.
5. Linear Algebra: Theory & Appl. - Ward Cheney & David Kincaid Viva Books, Jones & Bartlett.
6. Vector Calculus, Linear Algebra & Differential Forms: A unified approach - Hubbard J. & Hubbard B. Prentice Hall 1999
7. Introduction to Linear Algebra - Serge Lang, Springer, India.
8. Finite Dimension Vector Spaces - P. R. Halmos.
9. Linear Algebra Problem Book - P. R. Halmos.
10. Linear Algebra with Applications - Jeanne, L. Agnew & Robert C. Knapp Brooks / Col publishing Co, California.
11. A First Course in Linear Algebra – Dr. Alok Nath Chakrabarti. ISBN: 9788182091306. Tata McGraw-Hill Edu. Pvt. Ltd



**Semester III**  
**Course Code: MT 3503L**  
**(Based on MT 3501, MT 3502 and Numerical Methods-I)**  
**No. of Credits: 03**  
**Learning Hours: 60 hrs**

**Unit 1:**

1. Problems on different types of errors and to find missing terms from the given table and to express a polynomial in terms of factorial notations.
2. Newton's forward interpolation and Newton's backward interpolation.
3. Gauss's forward interpolation and Gauss's backward interpolation
4. Stirling's, Bessel's and Everette's interpolation

**Unit 2:**

5. Lagrange's interpolation and Newton's divided interpolation
6. Inverse interpolation for equispaced arguments (Only Newton's forward interpolation and Newton's backward interpolation and Gauss's forward interpolation)
7. Inverse interpolation for unequispaced arguments (Newton's divided and Lagrange's inverse interpolation)
8. LU Factorization Method.

**Unit 3:**

9. Gauss Jacobi iterative method and Gauss Seidel iterative method.
11. Curve Tracing- 1 (Cartesian curves in  $R^2$ ), some simple graphs
12. Curve Tracing-2 (Parametric curves in  $R^2$ ), some simple graphs
13. Curve Tracing-3 (Polar curves in  $R^2$ ), some simple graphs

**Unit 4:**

13. Examples on Limit, Continuity and Differentiation of functions of several variables using definition.
14. Examples on Euler's theorem and Examples on Extreme values.
15. Examples on subspace, bases and dimension theorem.
16. Matrix Associated with Linear map and linear map associated with matrix.

**Reference Books:**

1. Numerical Analysis and Computational Procedures –S. A. Mollah.
2. Elementary Numerical Analysis - Shastry.
3. Numerical Mathematical Analysis - James Scarborough.
4. Numerical Analysis - S. Kunz.
5. Numerical Methods for Scientific and Engineering Computation- 6<sup>th</sup> Edition, M. K. Jain, S. R. Iyengar, R. K. Jain, New Age International Publishers.
6. Numerical Analysis with C++ programming, Nita H. Shah, PHI Learning Ltd.

**Semester III (Mathematics)**

**Course Code: EG 3301 Logical and Analytical Reasoning (Elective)**

**No. of Credits: 02**

**Learning Hours: 30 hrs**

**Unit 1**

Number System, LCM and HCF, Divisibility Rules, Factors, Remainders and Factors, Progressions

**Unit 2**

Number and Letter Series, Calendars, Clocks, Venn Diagrams, Binary Logic

**Unit 3**

Seating Arrangement, Logical Matching, Logical Connectives, Syllogism, Odd one out

**Reference Books:**

1. A Morden Approach to Logical Reasoning , R.S. Aggarwal, S. Chand, First Edition, 2007.
2. 501 CHALLENGING LOGIC AND REASONING PROBLEMS, Gnanadeep, Learning Express, LLC, 2005.
3. Analytical Reasoning, N K Pandye, Third Edition, BSC publishing, 2012.

**Semester IV (Mathematics)**

**Course Code: MT 4501**

**Advanced Calculus-II (Theory)**

**No. of Credits: 04**

**Learning Hours: 60 hrs**

**Unit 1: Multiple integrals**

Introduction to double integral, repeated or iterated integral, double integral over a closed region, evaluation of double integral, changing the order of double integral, triple integrals, Iterated triple integrals, Geometrical interpretation of double and triple integrals and problems based on it, Introduction to Jacobian(only definition), transformation of double and triple integrals.

**Unit 2: Beta and Gamma functions and Vector calculus**

1. Definition of beta and gamma functions, properties of beta and gamma functions, relation between beta and gamma functions, duplication formula, evaluation of definite integrals using beta-gamma functions.
2. Definition of gradient, divergence and curl, properties of these operators,

**Unit 3: Line surface and volume integrals**

Definition of line integral, Green's theorem, surface and volume integral, Gauss's divergence theorem, Stoke's theorem, verification of the three theorems and problems based on the theorems.

**Unit 4: Partial Differential Equations**

Formation of Partial differential equations by the elimination of arbitrary constants and arbitrary functions, Partial differential equations of the first order, the complete and particular integrals, Lagrange's solution of the linear equation, Some special types of equations which can be solved easily by the methods other than Charpit's method.

**Reference Books:**

1. Mathematical Analysis – S. C. Malik and Savita Arora, Second Edition, New Age Int. (P) Ltd.
2. Integral calculus – Shanti Narayan.
3. Calculus – Second Edition, David V. Widder, PHI.
4. Calculus: Early Transcendentals, James Stewart, Indian Edition, Cengage Learning India Pvt Ltd.
5. Partial Differential Equations - T. Amarnath.
6. Ordinary and Partial Differential Equations – Nita H Shah, PHI Learning.
7. Calculus & Analytic Geometry - G. B. Thomas & R. L. Finney, Addison - Wesley pub. India.
8. Elements of Partial Differential Equations- Ian N. Sneddon, McGraw Hill co.
9. Advanced Calculus Volume I &II – T. M. Apostol.

## **Semester IV (Mathematics)**

**Course Code: MT 4502**

**Abstract Algebra-I (Theory)**

**No. of Credits: 04**

**Learning Hours: 60 hrs**

### **Unit 1:**

Relation, Equivalence Relation, Partition of set, Binary operations, Division Algorithm for Integers, Congruence modulo Relation in  $\mathbb{Z}$ , Groups, elementary properties, Finite Groups and Group tables, Commutative and non-commutative groups.

### **Unit 2:**

Subgroups, normalizer and centralizers, order of an element, order of a group, cyclic subgroup generated by an element, Lattice diagrams of finite groups, cosets and their properties, Lagrange's theorem and their applications, Euler's theorem, Fermat's theorem.

### **Unit 3:**

Permutations, cycle, transposition, even and odd permutations, order of a permutation, inverse of a permutation, Symmetric groups and Alternating groups, normal subgroups, quotient group.

### **Unit 4:**

Isomorphism of groups: Definitions and Examples, Cyclic Groups: Properties of Cyclic Groups, Isomorphism of Cyclic Groups.

Homomorphism of groups: Definitions and Examples, Kernel of a Homomorphism, Fundamental Theorem of Homomorphism, Cayley's Theorem.

### **Text Book:**

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 - DipakChatterajee, PHI Learning Pvt. Ltd, New Delhi.
5. Algebra - Michael Artin, PHI.
7. A survey of Modern - G.B irkhoff & S. Maclane, Algebra Univ. Press.
8. A first course in Abstract Algebra (Rings, Groups & fields) - Marlow Anderson & Todd Fel, Chrpman & Halilereivy.
9. Contemporary Abstract Algebra, Joseph A. Gallian, 7th EDITION, cengage learning.

## **Semester IV (Mathematics)**

**Course Code: MT 4503L** Practicals (Based on MT 4501, MT 4502 and Numerical Methods-II)

**No. of Credits: 03**

**Learning Hours: 30 hrs**

### **Unit 1:**

1. Problems based on relation between roots and coefficients of polynomial equations and problems of finding equations from given conditions.
2. Cardon's method to solve a cubic polynomial equation
3. Ferrari's method to solve a bi-quadratic polynomial equation
4. Graphical method to find a real root of an equation.

### **Unit 2:**

5. Bisection method and method of false position
6. Fixed point iteration method and Newton-Raphson's method
7. Euler's method and Modified Euler's method to solve an IVP.
8. Taylor's series method and Picard's method to solve an IVP.

### **Unit 3:**

9. Runge-Kutta method of order two and order four to solve an IVP.
10. Numerical differentiation for equispaced arguments: Newton's forward and backward differentiation formula, Gauss's forward differentiation formula
11. Numerical differentiation for unequispaced arguments: Newton's divided difference interpolation and Lagrange's interpolation formula.
12. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's rule.

### **Unit 4:**

13. Problems on change of the order of integration.
14. Problems on line integrals and volume integrals.
15. Group of Symmetircs
16. Examples of cyclic group and its subgroups and lattice diagrams.

### **Reference Books:**

1. Numerical Analysis and Computational Procedures –S.A.Mollah.
2. Numerical Analysis with C++ programming – Nita H Shah. PHI Learning.
3. Elementary Numerical Analysis - Shastry.
4. Numerical Mathematical Analysis - James Scarborough.
5. Numerical Analysis - S. Kunz.
6. Numerical Methods for Scientific and Engeengering Computation - 6<sup>th</sup> Edition, M. K. Jain, S. R. Iyengar, R. K. Jain, New Age International Publishers.

## **Semester IV (Mathematics)**

**Course Code: EG 4301** Elective

**No. of Credits: 02**

**Learning Hours: 30 hrs**

### **Unit 1**

- a) Software installation
- b) LATEX typesetting basics
- c) LATEX math typesetting
- d) Tables and matrices

### **Unit 2**

- a) Graphics
- b) Packages
- c) User-definable
- d) Document classes

### **Unit 3**

- a) Introductory notions. Handling errors.
- b) Bibliographies and indices
- c) beamer
- d) Creating your own packages

### **Books:**

- a) <http://www.dickimaw-books.com/latex/novices/novices-report.pdf>
- b) [http://www.stats.ox.ac.uk/pub/susan/oucs latex/Further LaTeXHandbook:pdf](http://www.stats.ox.ac.uk/pub/susan/oucs%20latex/Further%20LaTeXHandbook.pdf)

### **General information**

- a) The TEXUsers Group Web Site
- b) Getting started with TEX, LATEX, and Friends
- c) TEXResources on the Web
- d) LATEX- A document preparation system
- e) The TEXShowcase
- f) What the heck is LATEX?
- g) What is TEX?
- h) LATEXentry from Wikipedia
- i) TEXblog - Typography with TEX and LATEX
- j) TeXample.net

# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester V (Mathematics)

### MAT 5501: Linear Algebra – II (Theory)

Hours: 4 /week

Credits: 4

#### Unit I:

Composition of Linear Maps, The Space  $L(U,V)$ , Operator Equation, Linear Functional, Dual Spaces, Dual of Dual, Dual Basis Existence Theorem, Annihilators, Bilinear Forms.

#### Unit II:

Inner Product Space, Norm, Cauchy-Schwarz Inequality, Orthogonalization and Orthonormalization of Basis, Gram-Schmidt Orthogonalization Process. Orthogonal Complement and its properties. Orthogonal Transformations.

#### Unit III:

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

#### Unit IV:

Eigen values and Eigen vectors of linear operators and square matrices, Caley-Hamilton's Theorem and its verification. Application to reduction of Quadrics, Classification of Quadrics, Diagonalization of real and symmetric Matrices, Spectral Theorem.

#### Text Book:

1. An Introduction to Linear Algebra – V. Krishnamurthy and others, Affiliated East-West press, New Delhi.
2. Linear Algebra a Geometric Approach – S. Kumaresan, PHI.
3. Linear Algebra – I H Sheth, Nirav Prakashan.

#### Reference Books:

1. Linear Algebra with Applications – Otto Bretscher– 3<sup>rd</sup> ed. –Pearson Education.
2. An Introduction to Linear Algebra – I. K. Rana, Ane Books Pvt. Ltd., New Delhi.
3. Matrix and Linear Algebra by – K.B.Datta, Prentice Hall, New Delhi.
4. Linear Algebra: Theory & Applications - Ward Cheney & David Kincaid Viva Books, Jones & Bartlett.
5. Vector Calculus, Linear Algebra & Differential Forms: A unified approach - Hubbard J & Hubbard B., Prentice Hall 1999.
6. Linear Algebra with Applications -Jeanne, L. Agnew & Robert C. Knapp Brooks / Col publishing Co, California.
7. A First Course in Linear Algebra – Dr. Aloknath Chakrabarti. ISBN: 9788182091306. Tata McGraw-Hill Edu. Pvt. Ltd.

8. Elementary linear algebra with applications- H. Anton (9 th Edition), Wiley-India.(2008)
9. Linear Algebra and its applications- G. Strang, (4 th Edition), Thomson.(2006)
10. Linear algebra- Kenneth M Hoffman and Ray Kunze, (2<sup>nd</sup> Edition), Prentice Hall Inc.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester V (Mathematics)

### MAT 5502: Analysis – I (Theory)

Hours: 4 /week

Credits: 4

#### Unit I: The Real Numbers

- 1.1 Sets and Functions
- 1.2 Finite and Infinite Sets
- 1.3 Algebraic and Order properties of  $\mathbb{R}$
- 1.4 Absolute Value and Real Line
- 1.5 The completeness Property of  $\mathbb{R}$
- 1.6 The Applications of Supremum Property
- 1.7 Intervals

Articles 1.1, 1.3, 2.1 to 2.5 of Text Book (2)

#### Unit II: Sequences

- 2.1 Sequences and limits
- 2.2 Limit Theorems
- 2.3 Monotonic sequences
- 2.4 Sequences defined inductively
- 2.5 Subsequence (includes  $\limsup$  and  $\liminf$ )
- 2.6 Cauchy Sequences
- 2.7 Infinite limits

Articles 2.1-2.7 of Text Book (1)

#### Unit III: Functions and continuity

- 3.1 Limit of a function
- 3.2 Limit theorems and Other Limits
- 3.3 Continuity. Intermediate values, extreme values
- 3.4 Uniform continuity
- 3.5 Monotone and Inverse functions

Articles 3.1-3.6 of Text Book (1), Article 5.6 of Text Book (2)

#### Unit IV: The derivative

- 4.1 Definition and Rules for differentiation
- 4.2 Mean value theorems
- 4.3 Inverse functions
- 4.4 Intermediate value Property of Derivatives
- 4.5 L'Hospital's Rules

Articles 4.1 to 4.4 of Text Book (2), Sections 6.2.11 and 6.2.12, Article 6.3 of Text Book (2)

#### Text Books:



1. An Introduction to Analysis - Gerald G. Bilodeau, Paul R. Thie and G. E. Keough. Jones and Bartlett Student edition.
2. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition, 2010.

**Reference Books:**

1. A Course in Calculus & Real Analysis – S. R. Ghorpade & B. V. Limaye.
2. Elementary Analysis: the theory of calculus - K. Ross, Springer, India.
3. Numbers to Analysis - I. K. Rana, World scientific.
4. Calculus - Michael Spivak.
5. Principles of Mathematical Analysis- W. Rudin, McGraw-Hill
6. Fundamentals of mathematical analysis- G. Das & S Pattanayak, Tata Mcgraw Hill Pub. Co. Ltd.
7. A First course in Analysis- D. Somasundaram& B. Choudhary

## St. Xavier's College (Autonomous) Ahmedabad-09

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### Choice Based Credit System

#### Syllabus for Semester V (Mathematics)

#### **MAT 5503: Complex Variables and Fourier series (Theory)**

**Hours: 4 /week**

**Credits: 4**

#### **Unit I:**

Sum and product of complex numbers with properties, moduli and conjugate, triangle inequality, polar coordinates, product and quotients in exponential form, roots of complex numbers, de Moivre's theorem and application, the exponential function, trigonometric functions, hyperbolic functions, convergence of sequence and series.

#### **Unit II:**

Functions of complex variables, theorems on limits, continuity, derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient condition for differentiability, polar coordinates, analytic functions and harmonic functions.

#### **Unit III:**

Linear transformations, linear fractional transformations, Elementary transformation, an implicit form, preservation of angles, further properties.

#### **Unit IV:**

Fourier series, Bessel's inequality, Riemann-Lebesgue theorem.

#### **Text Books:**

1. Complex variables and applications – James W. Brown & Ruel V. Churchill, Mcgraw-hill inter. 6<sup>th</sup> edition, Articles 1 to 7, 23 to 25 and 43. Chapter 2 (omit art. 13). Articles. 68, 69, 70, 71, 79, 80.
2. A first course in Mathematical analysis – D. Somasundaram, Chapter-10.1 and 10.2 (only first two theorems).

**Reference books:**

1. Fundamentals of Mathematical Analysis- G. Das & S Pattanayak, Tata Mcgraw Hill Pub. Co. Ltd.
2. Analytical Geometry & Real and Complex analysis – T. Veerarajan, Mcgraw Hill.
3. Complex Analysis - V. Karunakaran, Narosa publishers.
4. Higher Engineering Mathematics – B. S. Grewal, Khanna Publishers.
5. Advance engineering Mathematics – H. K. Dass, S. Chand.
6. A First Course in Complex Analysis with Applications - Dennis G. Zill& Patrick S. Shanahan Jones & Bartlett India Pvt Ltd.
7. Complex Analysis - T. W. Gamelin, Springer (India) Ltd.
8. Theory of Complex functions – Marden & Hoffman W. H. Freeman, N.Y.
9. Functions of One Complex Variable – Conway.
10. An Introduction to Complex Analysis - A. R. Shastri, Macmilan India.
11. Fourier Analysis: An Introduction - E. M. Stein & R. Shakarchi, Princeton Uni. Press.
12. Fourier Series - R. Bhatia, Hindustan Book Agency-2010 corrected edition.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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**Choice Based Credit System****Syllabus for Semester V (Mathematics)****MAT 5504: Mathematical Programming (Theory)****Hours: 4 /week****Credits: 4****Unit I: Convex Set and Linear Programming Problem**

Convex set, Extreme points of a convex set, convex combination, Examples of Convex sets and Theorems on convexity. Formulation techniques of LP problems (Only Examples), Graphical Method, Simplex method for solving LPP.

**Unit II: Problem solving techniques for LP problems**

Big-M (Penalty) method, Two-Phase method, Integer programming problem (Only Gomory's cutting plane method).

**Unit III: Duality and Dual simplex method**

Introduction, Definition of the dual problem, general rules for converting any primal problem into it's dual, how to interpret the solution of the dual from its primal and vice versa, Comparison of the solution of the primal and it's dual. Find initial solution for dual simplex table, Mathematical procedure to find solution by dual simplex method.

**Unit IV: Transportation and Assignment Problems**

Introduction, Mathematical formulation, Tabular representation, Definitions, Methods for finding initial basic feasible solution (North West Corner Rule, Least Cost Method, Vogel's Approximation Method), Optimality test (MODI method), Degeneracy in Transportation

Problem, Unbalanced Transportation Problem. Introduction of Assignment problem, Mathematical formulation of Assignment problem, Method for solving Assignment problem (Hungarian Method), Unbalanced Assignment problem, Examples.

**Text Book**

Optimization method in O.R. & System Analysis - K. V. Mittal, New Age inter. Publishers.

**Reference books:**

1. Mathematical models in O.R. - J. K. Sharma, Tata-MacGraw Hills book-company.
2. Operations Research – Nita H Shah, Ravi Gor and Hardik Soni. PHI – Learning.
3. Operation Research - S. D. Sharma, Kedarnath Ramnath & Co.
4. Operation Research – Kanti Swaroop & Man Mohan, Sultan Chand & Co.
5. Linear Programming - L. I. Gass, Tata MacGraw Hills book-company.
6. Linear Programming - G. Hadley, Narosa Publishing house.
7. Operation Research- A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education.
8. Operations Research: An Introduction (9th Edition);, Hamdy A Taha, Pearson Education

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# St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System**

**Syllabus for Semester V (Mathematics)**

**MAT 5505 (Elective Course): Discrete Mathematics(Theory)**

**Hours: 3 /week**

**Credits: 2**

**Unit I:**

Binary Relation, Reflexive, Irreflexive, Symmetric, Antisymmetric, Transitive, Partial Ordering (omit lexicographic ordering), Hasse Diagram, Upper bound, lower bound, lub, glb, Lattice as a poset, Properties of lattices.

**Unit II:**

Lattice as an algebraic system (only definition), Sublattice, Homomorphism, Some Special Lattices, Boolean Algebra, Subalgebra, Direct Product, Homomorphism, Join Irreducible, Atoms.

**Unit III:**

Boolean Expression, Equivalent Boolean Expression, Minterm, Maxterm, Values of Boolean Expressions, Stone's Representation Theorem for finite Boolean Algebra, Sum of Products Canonical forms, Product of Sums Canonical forms.

**Text Book:**

1. Discrete Mathematical Structures with Applications to Computer Science -J. R. Tremblay and R. Manohar, Macgraw-Hill International Editions, ISBN 0-07-065142-6.  
Definitions: 2-3.3 to 2-3.7, Definition 2-3.16, 2-3.17(omit Lexicographic ordering), Article 2-3.9, Chapter 4 up to 4-3.

**Reference Books:**

1. Boolean Algebra and its Application – J. E. Whitesitt, Addison-Wesley Publishing Co. Inc.
2. Foundation of Discrete Mathematics – K. D. Joshi, New Age International Limited Publishers.
3. Logic and Boolean Algebra – B. H. Arnold, P H Inc LCCN 62-19100.
4. Introduction to Lattice Theory – D. E. Rutherford, University Mathematical Oliver and Boyed Ltd.
5. Modern Applied Algebra - Garret Birkhoff and Thomas C Barte, CBS Publishers and Distributors.
6. Sets Lattices and Boolean Algebras - James C Abbott.
7. Lattice Theory: First Concepts and Distributive Lattices – George A. Gratzner, Dover Books.

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## St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System**

**Syllabus for Semester V (Mathematics)**

**MAT 5505 (Elective Course): Combinatorics(Theory)**

**Hours: 3 /week**

**Credits: 2**

**Unit I: Permutations and Combinations:**

Basic Counting Principles, Permutations, Circular Permutations, Combinations, The injection and Bijection Principles, Arrangements and selection with Repetitions, Distribution Problems

**Unit II: Binomial Coefficients and Multinomial Coefficients:**

The Binomial Theorem, Combinatorial Identities, The Pascal's Triangles, Chu Shin-Chie's Identity, Shortest Routes in a Rectangular Grid, Some properties of Binomial Coefficients, Multinomial Coefficients and the Multinomial Theorem

**Unit III: The Pigeonhole Principle, Ramsey Numbers, the Principle of Inclusion and Exclusion:**

The Pigeonhole Principle and examples, Ramsey Type Problems and Ramsey Numbers, Bounds for Ramsey Numbers, The Principle of Inclusion and Exclusion, A Generalization, Integer Solutions and Shortest Problems, Surjection Mapping and Stirling Number of the second Kind, Derangements and A Generalization, The Sieve of Eratosthenes and Euler  $\varphi$  function.

**Text Book:**

Principles and Techniques in Combinatorics - Chen Chuan Chong and Koh Khee Meng, World Scientific Chapters 1 to 4 (omit 4.8).

**Reference Books:**

1. Combinatorial Techniques, Sharad Sane, Hindustan Book Agency
2. Combinatorics including concepts of Graph Theory - V. K. Balakrishnan, Schaum's Outline Series, McGraw-Hill, INC.
3. A Path to Combinatorics for Undergraduates Counting Strategies – Titu Andreescu and Zuming Feng, Birkhauser.
4. Introduction to Combinatorial Mathematics - C. L. Liu, McGraw Hill Book Company.
5. Introduction to Combinatorics - 4<sup>th</sup> Edition, Richard A. Brualdi, Pearson Education.
6. An Excursion in Mathematics, MR Modak, S A Katre, VV Acharya and VM Sholapurkar, BhaskaracharyaPratishthana, Pune.
7. A First Course in Graph Theory and Combinatorics, Sebastian M Cioaba and M Ram Murty, Hindustan Book Agency.

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**St. Xavier's College (Autonomous)**  
**Ahmedabad-09**

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## **Choice Based Credit System**

### **Syllabus for Semester V (Mathematics)**

#### **MAT 5505 (Elective Course): Financial Mathematics(Theory)**

**Hours: 3 /week**

**Credits: 2**

#### **Unit I:**

Basic Concepts: Arbitrage, Return and Interest, Time Value of Money, Bonds, Shares and Indices, Models and Assumptions.

#### **Unit II:**

Deterministic Cash Flows: Net Present Value (NPV), Internal Rate of Return (IRR), Comparison of IRR and NPV, Bonds price and yield, Clean and Dirty Price, Price – Yield Curves, Duration, Term structure of Interest rates, Immunisation, Convexity.

#### **Unit III:**

Random Cash Flows: Random Returns, Portfolio Diagrams and Efficiency, Feasible Set, Markowitz Model.

#### **Text Book:**

The Calculus of Finance - Amber Habib, University Press, Chapters 1, 2, 3 (upto 3.4).

#### **Reference Books:**

1. Financial Calculus: An Introduction to Derivative Pricing Hardcover – Martin Baxter & Andrew Rennie
2. Introduction to Mathematics of Finance – R.J. Williams, American Mathematical Society.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester V (Mathematics)

### MAT 5505 (Elective Course): Mathematical Statistics (Theory)

Hours: 3 /week

Credits: 2

#### Unit I: Theory of probability

Introduction, Basic terminology, Mathematical and statistical probability, Subjective probability, Mathematical tools ( Sets and elements of sets, Operation on sets, Algebra on sets, Limit of sequence of sets, classes of sets), Random experiment, Sample space, Elementary events, Event, Addition theorem of probability, Boole's inequality, Conditional probability, Multiplication theorem of probability, independent events, Multiplication theorem of probability for independent events, mutually independent events, Bayes' theorem.

#### Unit II: Random variable and some basic idea of distribution

Introduction, distribution function, Discrete random variable (probability mass function, discrete distribution function), Continuous random variable (probability mass function, continuous distribution function), Mathematical expectation, Expected value of function of random variable, properties of expectation, properties of variance, covariance, moment generating function(M.G.F), Cumulate generating function (C.G.F).

#### Unit III: Discrete and Continuous Probabilities distributions

Introduction, Bernoulli distribution, Binomial distribution (Moments, recurrence relation for the moments, recurrence relation for the probabilities, Moment generating function (M.G.F), Cumulate generating function (C.G.F), Characteristic), Poisson distribution (Moments, recurrence relation for the moments, recurrence relation for the probabilities, Moment generating function (M.G.F), Cumulate generating function (C.G.F), Characteristic), Negative binomial distribution, Normal distribution (Mode, Median, Moments, Moment generating function (M.G.F), Cumulate generating function (C.G.F), Characteristic), Exponential distribution (Moment generating function (M.G.F)), Beta distribution of first kind, Beta distribution of second kind.

#### Text Book:

Fundamentals of Mathematical Statistics - S. C. Gupta and V. K. Kappor, Sultan Chand and Sons, Educational Publishers, New Delhi.

#### Reference books:

- 1 An introduction to Probability Theory and Mathematical Statistics - V. K. Rohatgi, Wiley Eastern limited, New Delhi.
- 2 Elementary Mathematical Statistics - S. C. Gupta and V. K. Kappor, Sultan Chand and Sons, Educational Publishers, New Delhi.

3 Mathematical Statistics – Parimal Mukhopadhyay.  
4 Modern Probability Theory - B. R. Bhatt.

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# St. Xavier's College (Autonomous) Ahmedabad-09

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## Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

#### MAT 6505 (Elective Course): Mechanics (Theory)

Hours: 3 /week

Credits: 2

#### Unit I:

Foundation of Mechanics- The ingredients of mechanics (particles, mass, rigid bodies, events, frame of reference, time, units, rest of motion, force), Introduction of vectors, velocity and acceleration. Fundamental laws of Newtonian mechanics. The theory of dimensions.

#### Unit II:

Methods of Plane Statics- Equilibrium of a particle, Equilibrium of a system of particles, the moment of a vector about a line, the theorem of verignon, necessary condition for equilibrium equipollent system of forces, couples, reduction of a general plane force system, work, the principle of virtual work, sufficient condition for the equilibrium of a rigid body movable parallel to a fixed plane. Potential energy

#### Unit III:

Mass centers and centre of gravity, Theorem of Pappus, gravitation, centre of gravity. Friction, laws of Static and kinetic friction, thin beams, flexible cables, differential equation of flexible cables, the suspension bridge, the common catenary, cables in contact with smooth curves, cables in contact with rough curves,

#### Text Book:

Principles of Mechanics - John L. Synge and Byron A. Griffith . Mc Graw Hill Book Comp.-New Delhi.

#### Reference Books:

1. Introduction to classical Mechanics - R. G. Takwale& P. S. Puranik. Mc Graw Hill Book Comp.-New Delhi.
2. A Text Book on Mechanics - P. N. Sinhal& S. Sareen, Anmol Publications Pvt. Ltd., New Delhi
3. Classical Mechanics - Herbert Goldstein, Addison –Wesley Publishing Company, INC.
4. Classical Mechanics – T. W. B. Kibble, Longman scientific & Technical Co-published in US with John Wiley& Sons Inc., New-York.
5. Mechanics - S. L. Kalani, C. Hemrajani, Shubhara Kalani, Viva Books Pvt. Ltd., New Delhi



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# St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System**

**Syllabus for Semester V (Mathematics)**

**MAT 5505 (Elective Course): Number Theory (Theory)**

**Hours: 3 /week**

**Credits: 2**

**Unit I:**

Some Preliminary Consideration: Well-Ordering Principle, Mathematical Induction, the Binomial Theorem & binomial coefficients.

Divisibility Theory: the division algorithm, divisor, remainder, prime, relatively prime, the greatest common divisor, the Euclidean algorithm (Without proof), the least common multiple, the linear Diophantine equation & its solution.

**Unit II:**

Prime Numbers: Prime and composite number, the Fundamental Theorem of Arithmetic (without proof), canonical form of a number, the Sieve of Eratosthenes.

Theory of Congruence: Definition and basic properties of congruence, Residue class & complete system of residues, special divisibility test, linear congruence, Chinese Remainder Theorem. (without proof)

**Unit III:**

Fermat's Theorem: Fermat's Factorization method, Fermat's little theorem, Wilson theorem,

Euler's theorem: Euler's Phi-function  $\phi(n)$  and formula for  $\phi(n)$ , Euler's theorem (without proof) and only problems on Euler's theorem.

**Text Book:**

Elementary Number Theory - David M. Burton, Sixth Edition, Universal Book stall, New Delhi.

[(Chapter 1): 1.1 and 1.2 2) 2.1 to 2.4 3) 3.1 and 3.2 4) 4.1 to 4.3 5) 5.2 and 5.3 7) 7.2 and 7.3

**Reference Books:**

1 An introduction to the Theory of numbers - Niven ,Zuckerman and Montgomery, Wiley Eastern Ltd.

- 2 Number Theory - S. G. Telang, Tata Mc Graw-Hill Publishing Company Limited, New Delhi
- 3 Elementary Theory of Numbers - C. Y. Hsiung, Allied Publishers Ltd.-India.
- 4 Number Theory - George E. Andrews, Hindustan Publishing Corporation- Delhi.
- 5 Elementary Number Theory - Gareth A. Jones & J. Mary Jones, Springer Verlag, ISBN 81-8128-278-7.
6. Number Theory - J. Hunter, Oliver and Boyd-London.
7. Beginning Number Theory - Neville Robbins, Narosa Pub. House -New Delhi ISBN 978-81-7319-836
- 8 Introduction to the theory of Numbers - G. H. Hardy & E. M. Wright, Oxford Uni. Press
- 9 Higher Algebra - S. Barnard & J. M. Child, Macmillan India Ltd
- 10 Elements of Number Theory - I. M. Vinogradov , Dover Pub INC
- 11 Elementary Number Theory in Nine chapters - James J. Tattersall, Cambridge Uni Press
- 12 A first course in Theory of Numbers - K. C. Chowdhary, Asian Books Pvt Ltd New Delhi
- 13 1001 problems in Classical Number Theory - Jean Marie De Konick Armed Mercier, AMS
- 14 An Excursion in Mathematics, MR Modak, S A Katre, VV Acharya and VM Sholapurkar, BhaskaracharyaPratishthana, Pune.

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## St. Xavier's College (Autonomous) Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester V (Mathematics)

**MAT 5506L: Practical - 1(Based on MAT5501, MAT5502)**

**Hours: 6 /week**

**Credits: 2.5**

#### List of Practical:

##### Unit I:

1. Examples of solving an operator equation,
2. Examples of finding dual bases for  $\mathbb{R}^2$  and  $\mathbb{R}^3$  from their given bases through the Dual-Basis-Existence-Theorem.
3. Examples of orthogonalization and orthonormalization of basis through Gram-Schmidt orthogonalization process.
4. Examples of determinants using their properties.

##### Unit II:

5. Some Geometrical Linear Transformations (Reflection, Rotation, Shear ect.)
6. Applications of Cayley-Hamilton Theorem.
7. Examples of diagonalization of square matrices.
8. Identifications of conic and Quadrics

**Unit III:**

9. Countable and Uncountable Sets
10. Completeness property of  $\mathbb{R}$  - problems related to infimum, supremum of sets,
11. Limits of sequences including inductively defined sequences, limit inferior and superior
12. Cauchy Sequences

**Unit IV:**

13. Types of discontinuities-discussion and examples
14. Uniform continuity.
15. Problems based on Mean Value Theorems and L'Hospital's Rule
16. Application of Intermediate Value theorem and Modelling using differentiation

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# St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System****Syllabus for Semester V (Mathematics)****MAT 5506L: Practical - 2(Based on MAT5503, MAT5504)****Hours: 6 /week****Credits: 2.5****List of Practicals:****Unit I:**

1. Application of De-Moivre's theorem
2. Verification of Cauchy-Riemann equations (Cartesian & polar form).
3. Find the harmonic conjugate of a function and hence find corresponding analytic function.
4. Solving equation involving elementary complex valued functions

**Unit II:**

5. Problems on transformation under elementary complex valued functions
6. Problems on verification of conformal mappings.
7. Find the Fourier series of functions –I.
8. Find the Fourier of functions-II.

**Unit III:**

9. Solve Linear Programming Problem by simplex method-I (3 problems)
10. Solve Linear Programming Problem by big-M method and Two-phase method (4 problems)
11. Solve Linear Programming Problem by method (3 problems)
12. Solve Integer programming problem (Only Gomory's cutting plane method). (3 Problems)

**Unit IV:**

13. Using duality solve Linear Programming Problem (3 problems)
14. Using MODI method to solve Transportation problem (Balanced) (3 problems)
15. Using MODI method to solve Transportation problem (Unbalanced) (3 problems)
16. Using "Hungarian method" to solve Assignment problem (Balanced and Unbalanced) (3 Problems)

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## St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System****Syllabus for Semester VI (Mathematics)****MAT 6501: Abstract Algebra-II (Theory)****Hours: 4 /week****Credits: 4****Unit I:**

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: 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: 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 zero of polynomial.

### **Unit IV:**

Fields: Fields, Subfields, Extension field, The field of quotients and integral domain, Prime fields, Finite fields, Maximal ideals, Prime ideals and their characterization through quotient ring.

### **Text Book:**

Abstract Algebra - I. H. Sheth, Prentice-Hall of India Pvt. Ltd. New Delhi, Second edition - 2003

### **Reference Books:**

1. Abstract Algebra Theory and Applications -Thomas W. Judson, Stephen F. Austin State University, 2009.
2. Basic Abstract Algebra - Bhattacharya P.B., Jain S. K. and Nagpal S. R., Foundation Books, New Delhi.
3. A First Course in Abstract Algebra - Fraleigh J.B., Narosa Publishing, New Delhi.
4. Topics in Algebra – I. N. Herstein, Vikas Publishing, New Delhi.
5. Algebra - Michael Artin, PHI.
6. A survey of Modern Algebra - G.Birkhoff& S. Maclane, Uni. Press.
7. Proofs from the Book –M Aigner, G M Ziegler and Hofmann, Springer

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# St. Xavier's College (Autonomous) Ahmedabad-09

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## **Choice Based Credit System**

## **Syllabus for Semester VI (Mathematics)**

## **MAT 6502: Analysis-II (Theory)**

**Hours: 4 /week**

**Credits: 4**

**Unit I: Riemann Integration**

- 1.1. Definition of the integral
- 1.2. Properties of the integral
- 1.3. Existence theory (monotone, continuous functions etc. (includes Riemann sums)
- 1.4. Fundamental theorem
- 1.5. Integration by parts and change of variable
- 1.6. Mean value theorems (Weierstrass's Form and Bonnet's Form)

Articles 5.1 to 5.5 of (I); 1.5 and 1.6 to be supplemented from reference books

**Unit II: Infinite series**

- 2.1 Basic Theory (covers upto comparison test)
- 2.2 Series with positive terms (Condensation Test, Pringsheim's Test)
- 2.3 Absolute convergence (includes alternating series), ratio and root tests with  $\limsup$  and  $\liminf$

Articles 6.1, and 6.2 of (I); 2.2 to be supplemented from reference books.

**Unit III: Infinite Series –II**

- 3.1 Rearrangement of series, Cauchy Product of Series, Merten's theorem
- 3.2 Power Series
- 3.3 Improper integrals of the first and second kind.

3.1 to be supplemented from reference books; others from Articles 6.3 and 5.5 of (I)

**Unit IV: Taylor Series**

- 4.1 Taylor's Theorem with Lagrange and Cauchy form of remainders
- 4.2 Expansions of exponential, logarithmic and trigonometric functions
- 4.3 Binomial series theorem
- 4.4 Power series solutions of differential equations

Articles 6.4 and 8.3 of (I); 4.2 and 4.3 to be supplemented from reference books

**Text Book:**

1. An Introduction to Analysis, Gerald G. Bilodeau, Paul R. Thie and G.E. Keough.  
Jones and Bartlett Student edition

**Reference Books:**

1. Fundamentals of Mathematical Analysis, Das and Pattanayak, TMH.
2. Calculus Vol 1, Tom M. Apostol.
3. Principles of Mathematical Analysis, W. Rudin, McGraw-Hill
4. Mathematical Analysis by Tom M. Apostol, Narosa Publ. House India.
5. Calculus, Michael Spivak.
6. Understanding Analysis - Stephen D. Abbott.
7. A Course in Calculus & Real Analysis - S. R. Ghorpade & B. V. Limaye.
8. Elementary Analysis: the theory of calculus - K. Ross, Springer, India.
9. Numbers to Analysis - I. K. Rana, world scientific.
10. Mathematical Analysis- Andrew Browder, Springer ISBN No. 978-81-8489-520-9.
11. A First course in Analysis- D. Somasundaram & B. Choudhary, Narosa Publication.
12. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition, 2010.

# St. Xavier's College (Autonomous)

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# Ahmedabad-09

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## Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

#### MAT 6503: Analysis-III (Theory)

Hours: 4 /week

Credits: 4

#### Unit I: Metric Spaces

- 1.1. Definition and Examples.
- 1.2. Open Sets.
- 1.3. Closed Sets
- 1.4. Convergence, Completeness and Baire's Theorem

Articles 9, 10, 11 and 12 of Text Book (1)

#### Unit II: Continuity, Compactness and Connectedness

- 2.1 Continuous mappings
- 2.2 Compactness
- 2.3 Continuous function on compact set
- 2.4 Connected set
- 2.5 Continuous function on connected set

This should be covered from Text Book (4)

#### Unit III: Uniform Convergence

- 3.1 Pointwise Convergence
- 3.2 Uniform Convergence
- 3.3 Uniform Convergence and Continuity
- 3.4 Uniform Convergence and Differentiation
- 3.5 Term by Term Integration of Series
- 3.6 Term by Term Differentiation of Series

Articles 9.1-9.5 of Text Book (2)

#### Unit IV: Applications of Uniform Convergence

- 4.1 Abel's Limit Theorem, Multiplication of Power Series
- 4.2 Taylor's Series
- 4.3 Weierstrass's Approximation Theorem
- 4.4 Exponential, Logarithmic and Trigonometric Functions

Articles 9.6-9.8 of Text Book (2), 4.5 from section 8.3 and 8.4 of Text Book (3)

#### Text Books:

1. Topology and Modern Analysis - G. F. Simmons.
2. Fundamentals of Mathematical Analysis - Das and Pattanayak, TMH.
3. Introduction to Real Analysis - Robert G. Bartle and Donald R. Sherbert, Wiley Student Edition, 2010.
4. A First course in Analysis- D. Somasundaram & B. Choudhary, Narosa Publication.

#### Reference Books:

1. A Course in Calculus & Real Analysis - S. R. Ghorpade & B. V. Limaye
2. Elementary Analysis: the theory of calculus - K. Ross, Springer, India.
3. Numbers to Analysis - I. K. Rana, World Scientific.
4. Metric Spaces - Shirali, Springer, India.
5. Topology of Metric Spaces - S. Kumaresan, Narosa
6. An Introduction to Analysis - Arlen Brown & Carl Pearcy, Springer, India.
7. Analysis I By Herbert Amann & Joa Chim Escher, Birkhauser Verlag, Berlin.
8. Mathematical Analysis: Linear & Metric Structure & Continuity - Mariano Giaquinta & Giuseppe Modica Birkhauser, Boston.
9. Mathematical Analysis- Andrew Browder, Springer ISBN No. 978-81-8489-520-9.

# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

### MAT 6504: Graph Theory(Theory)

Hours: 4 /week

Credits: 4

#### Unit I:

Graph, Graphs as Models, More Definitions, Vertex Degrees, Subgraphs, Path and Cycles.

#### Unit II:

The Matrix Representation of Graphs, Fusion, Definition and simple properties, Bridges.

#### Unit III:

Spanning Trees, Connector problems (Omit the proofs of theorems 2.14-2.18), Shortest path Problems, Cut vertices and Connectivity.

#### Unit IV:

Euler Tours, (Omit the proof of Theorem 3.5), Hamiltonian Graphs.

#### Text Book:

A First Look at Graph Theory - John Clark and Derek Allan Holton, Allied Publishers Limited, Chapters 1 to 3 (Omit 3.2 and 3.4).

#### Reference Books:

1. Introduction to Graph Theory - R. J. Wilson, Longman.
2. Introduction to Graph Theory - Douglas B. West, Prentice-Hall of India, Second Edition, 2006, ISBN-81-203-2142-1.
3. Invitation to Graph Theory - S. Arumugam, S. Ramchandran, Scitech Publication (India) Pvt. Ltd, Chennai.
4. A First Course in Graph Theory - S. A. Choudum, Macmillan India Limited, SBN 033392 040 6.
5. Graph Theory – G. Suresh Singh, Prentice Hall of India,
6. A First Course in Graph Theory and Combinatorics, Sebastian M Cioaba and M Ram Murty, Hindustan Book Agency.
7. Graph Theory Frank Harrary,
8. Graph Theory with Application- John Bondy and U.S.R Murty, Palgrave.
- 9 Graph Theory- Reinhard Diestel, 4<sup>th</sup> edition 2010, Springer- Verlag.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

### MAT 6505 (Elective Course): Convex Analysis and Probability Theory (Theory)

Hours: 3 /week

Credits: 2

#### Unit I:

Convex Analysis: Convex and concave sets, Affine sets & Hyperplanes, Convex combination, Convex cones, Algebra of convex sets: Convex functions and discussion of its continuity, graphs, sequences, limits, maxima & minima, monotonicity, linearity on an interval & convex sets, Convexity & connectedness and discussion of differentiability of convex functions. Examples, counter examples and theorems based on them.

#### Unit II:

Jensen inequality and its consequences & related results. A.M., G.M., Quadratic Mean (Q.M) inequality, logarithmic mean and convexity. Problems, Lagrange Mean Value Theorem(LMVT) & Convexity. Probability as a stochastic (uncertainty) mathematical model. Axiomatic & classical definition of probability, Sample space, events, probabilistic 2-set, 3-set, n-set. Inclusion & Exclusion and examples: Box office queue, Birthday problems, Bertrand's paradox. Independent, Conditional & geometric probability. Law of total probability.

#### Unit III:

Random walk & Random variable, Baye's Rule. Classical problems: Shakespeare's monkey Eccentric Warden, 3-prisoner's Dilemma, D'Alembert's Confusion Gambler's Ruin etc. Expected values & variance Binomial poison & normal Distributions Banach match-box problem & some classical problems.

#### Text Books:

1. Convex Analysis By R.Tyrrell Rockafellor, Princeton Uni. Press.
2. A course in Calculus & Real Analysis By Sudhir R. Ghorpade & Balmohan V. Limaye, Springer India. Pages:23, 24, 25, 34, 36 (ex.27 to 35), 42, (ex.71, 72), 74 to 77, 100, 102, 125 to 130 (ex.15), 174 (ex.12)
3. Probability: An Introduction By David A. Santos Viva Books Ch.3 & 4

#### Reference Books:

1. All the mathematics you missed but Need to Know - Thomas A. Garrity, Camb. Univ. Press.
2. An Introduction to Probability Theory & its Applications - Feller Vol. I John Wiley & sons, NY.
3. Introduction to Probability Models -Sheldom M. Ross, Academic Press, 9<sup>th</sup> Edition.

4. Probability & Probability Distributions (MS-8, Block:3), IGNOU, New Delhi.
5. Elementary Probability Theory - Chung, Springer, India.
6. What is Mathematics? - Courant & Robbins, Revised by Ian Stewart Pg.108 to 116.
7. Calculus, once again (for convex function & monotonicity) - David A. Santos.
8. Convex functions - A.W.Roberts and D.E.Varberg. Academic press.
9. Lecture slides on Convex Analysis & Optimization - Dimitri P. Bertsekas, MIT cambridge MASS.
10. Convex Analysis by Jose' De Dona; The Uni. of New Castle.
11. A course in Multivariable Calculus & Analysis - S. R. Ghorpade& B. V. Limaye Springer (India) pg:8, 9, 25, 26, 35(ex 5, 6, 7, 8), 37 (ex 23, 24, 25, 58 to 60 (for continuity & Convexity) Pg:125 & 126, 129 to 137.
12. Convex Analysis: An Introductory Text - J. Van Tid, John Wiley, New York.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

### MAT 6505 (Elective Course): Cryptography (Theory)

**Hours: 3 /week**

**Credits: 2**

#### Unit I:

Rings, Modular Arithmetic, Prime Numbers, Primitive Elements, Discrete Logarithm

#### Unit II:

Conventions in Representation, Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, A Case for Modern Cryptography.

#### Unit III:

Trapdoor Function, Diffie-Hellman(DH) Algorithms for Key Exchange, Algorithms for Discrete Logarithms, ElGamal Public-Key Cryptosystem, RSA Cryptosystem, Digital Signature.

#### Text Book:

Cryptography and Security - C K Shyamala, N Harini and Dr T R Padmanabhan Wiley-India.

Ch-1(omit1.5.6), ch-2(omit 2.9), ch-5(up to 5.5), ch-7.5(up to 7.5.2).

#### Reference Book:

1. Cryptography & Network Security - Behrouz A Forouzan and Debdeep Mukhopadhyay, McGraw Hill.
2. Cryptography – Atul Kahate.
3. Cryptography and information Security - V K Pachgrare, PHI, EEE.
4. Public-Key Cryptography Theory and Practice - Abhijit Das, Madhvan and C E Veni Pearson.
5. Cryptography, An Introduction- V.V. Yaschenko, Americal Mathematical Soc.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### **Choice Based Credit System**

### **Syllabus for Semester VI (Mathematics)**

### **MAT 6505 (Elective Course): Operations Research (Theory)**

**Hours: 3 /week**

**Credits: 2**

#### **Unit I: Inventory Problems**

Introduction, types of inventory, cost involved in inventory problems, notations, EOQ model, limitations of EOQ formula, EOQ model with finite replenishment rate, EOQ model with shortages, Order – level Lot – size model, Order – level Lot – size model with finite replenishment rate.

#### **Unit II: PERT and CPM**

Introduction, origin of PERT & CPM, applications of PERT & CPM, framework of PERT & CPM, construction of project network, dummy activities and events, rules for network construction, finding the critical path, concepts of float, total float and free float and its interpretations.

#### **Unit III: Game Theory**

Introduction, Two person zero-sum games, Maximin and Minimax Principles, Mixed strategies, expected pay-off, solution of  $2 \times 2$  mixed strategy game, solution of mixed strategy game by the method of oddments, Dominance Principle, solution of mixed game by matrix method, solution of a two person zero-sum  $2 \times n$  game, Algebraic method for solving

a game, solution of  $3 \times 3$  games with mixed strategy by the method of oddments, Iterative method for approximate solution.

**Text Book:**

Operations Research - Nita H. Shah, Ravi M. Gor and Hardik Soni, PHI learning.  
Chapter 11 (11.1 – 11.10), Chapter 15 (15.1 – 15.9) and Chapter 18 (18.1 – 18.14).

**Reference books:**

1. Operations Research: An Introduction (9th Edition);, Hamdy A Taha, Pearson Education
2. Mathematical models in O.R. - J. K. Sharma, Tata-MacGraw Hills book-company.
3. Operation Research - S. D. Sharma, Kedarnath Ramnath & Co.
4. Operation Research – Kanti Swaroop & Man Mohan, Sultan Chand & Co.

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## St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System**

**Syllabus for Semester VI (Mathematics)**

**MAT 6505 (Elective Course): Bio-Mathematics (Theory)**

**Hours: 3 /week**

**Credits: 2**

**Unit I:**

Mathematical Models in epidemiology : Basic concepts, SI model, SIS model with constant coefficient, SIS model with coefficient as a function of time  $t$ , SIS model with constant number of carriers, SIS model when the carriers is a function of time  $t$ , SIR model, Epidemics with vaccination.

**Unit II:**

Single-species population models – Age structured : Continuous-time continuous-Age-Scale population models, Lotka's model for population growth, Discrete-Time Discrete-

Age-Scale population model, Bernardelli, Lewis and Leslie (BLL) model, Density Dependence model, Two-sec models, Continuous-time Discrete-Age population model.

**Unit III:**

Single-species population models – non-age structured: Exponential Growth model, its formulation, solution and interpretation, Effects of immigration and Emigration on population, Logistic Growth model, its formulation, solution and interpretation.

**Text Book:**

Bio-Mathematics - S. K. Aggarwal, ALP Books.

**Reference Book**

1. Mathematical Modelling- J N Kapoor, New Age Publishers.
2. Mathematical Biology I : J.D.Murray, Springer.

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## St. Xavier's College (Autonomous) Ahmedabad-09

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**Choice Based Credit System**

**Syllabus for Semester V (Mathematics)**

**MAT 5505 (Elective Course): C Programming for Mathematical Problems(Practical)**

**Hours: 3 /week**

**Credits: 2**

Instructions:

1. The programming language “C” should be used **only for** syntax and semantics. Detailed non-mathematical examples, which divert the attention, should be discarded from the discussion.
2. Each student should have to perform one practical for each week.

3. Each practical is of three lecture hours.

**Syllabus:** Importance of C, Basic Structure of C programs, Programming style, Executing a C program, Constants, Variables and Data types, Operators and Expressions, Managing Input Output Operations, Decision making and Branching, Decision making and Looping, Arrays.

Programs for Practical

Design an algorithm and write a program for each of the following:

**Unit I:**

1. To generate the first  $n$  terms of the Fibonacci sequence, where  $n \geq 1$ .
2. To find the greatest common divisor and the least common multiple factorial of given two non-zero integer.
3. To find all the prime numbers in the first  $n$  positive integers.
4. To find (i) all the prime divisors (ii) all the divisors (iii) the prime power factorization of a given positive integer.

**Unit II:**

5. To evaluate  $x^n$  for a given positive integer  $n$  and a given real number  $x$ .
6. To find the  $n$ th Fibonacci number without finding all the preceding Fibonacci numbers  $n$
7. To remove all duplicates from an ordered array and contract the array accordingly.
8. To partition the elements of a given randomly ordered array of  $n$  elements and a given an element  $x$  into two subsets such that the elements  $\leq x$  are in one subset and the elements  $> x$  are in the other subset.

**Unit III:**

9. To merge two monotonically increasing arrays into a single monotonically increasing array.
10. To sort a given randomly ordered array of  $n$  elements into non-descending order using (i) the selection sort method (ii) the exchange method (iii) Shell's diminishing increment insertion method.

**Text Books:**

1. For "C" programming language "Programming in ANSI C" covers the course -second edition E. BALAGURUSAMY, Tata McGraw-Hill Publishing Company Limited ISBN 0-07460401-5. Chapter 1-7, 9,11,13 (omit case studies, 7.8, 9.20, 11.16, 13.14)
2. Algorithms and practicals are covered by "How to Solve It by Computer"-R. G. Dromey (second edition) Prentice Hall of India.

**Reference book:**

1. Algorithms + Data Structures = Programs Niklaus Wirth-Prentice-Hall of India ISBN-81-203-05698.
2. Numerical Methods with C++ programming – Nita H Shah. PHI Learning.

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# St. Xavier's College (Autonomous)

## Ahmedabad-09

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### Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

### MAT 6506L: Practical-1(Based on MAT6501, MAT6502)

Hours: 6 /week

Credits: 2.5

### List of Practicals:

#### Unit I:

1. Verification of Rings, Commutative ring and ring with unity. Finite rings and their operation tables.
2. Examples of Ideals and Integral Domain.
3. Examples of finite fields and extension fields.
4. Construction of quotient ring and their operation tables.

#### Unit II:

5. Find the g.c.d. of two given polynomials and express it as a linear combination of these two polynomials.
6. Check the irreducibility of polynomial over the given field (By different methods)
7. Factorization of polynomial and the rational zeros of given polynomial.
8. Example of Maximal and prime ideal

#### Unit III:

9. Definition and evaluation of Riemann integrals by various methods
10. Verifying MVTs and problems based on Fundamental Theorem of Integration
11. Convergence of infinite series of positive terms
12. Absolute convergence, root and ratio tests using limit inferior and superior

#### Unit IV:

13. Power Series, radius of convergence
14. Improper integrals
15. Power series expansion of functions.
16. Power series solutions of differential equations

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# St. Xavier's College (Autonomous) Ahmedabad-09

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## Choice Based Credit System

### Syllabus for Semester VI (Mathematics)

#### MAT 6506L: Practical-2 (Based on MAT6503, MAT6504)

Hours: 6 /week

Credits: 2.5

#### List of Practicals:

##### Unit I:

1. Metric spaces, examples
2. Uniform convergence of sequences
3. Uniform convergence of series, term by term differentiation and integration
4. Multiplication of power series

##### Unit II:

5. Properties of exponential, logarithmic and trigonometric functions
6. Problems on compact and connected spaces.
7. One article to be chosen from journals/books and presented in own words with proofs
8. Oral presented of project which is done in practical 7.

##### Unit III:

9. Using the adjacency matrix determine whether the given graph is connected or not.
10. Determine whether the given graph is connected or not using fusion algorithm.
11. Find a minimal spanning tree of a given connected weighted graph using Kruskal's algorithm.
12. Find a minimal spanning tree of a given connected weighted graph using Prim's algorithm.

##### Unit IV:

13. Find a shortest path between two vertices of a given connected graph using the Breadth First Search algorithm.
14. Find a shortest path between two vertices of a given connected graph using the Back-tracking algorithm.
15. Find a shortest path between two vertices of a given connected weighted graph using the Dijkstra's algorithm.
16. Construct an Euler tour in a Euler graph using Fleury's algorithm.

#### References:



1. [www.mathworld.com](http://www.mathworld.com).
2. Selected Papers On Precalculus: Vol I – Edited by Tom M Apostol: The Mathematical Association of America:(MAA):ISBN 0-88385-200-4.
3. Selected Papers On calculus: Vol II – Edited by Tom M Apostol: The Mathematical Association of America:(MAA):ISBN 0-88385-200-4.
4. Resonance: The Indian Academy of Sciences: ISSN 0971-8044 .

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