Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for B.Sc. Mathematics

F. Y. B. Sc. Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
I	MAT1101	Algebra	2
	MAT1102	Calculus-I	2
	MAT1103	Practical Based on MAT1101 & MAT1102	2
II	MAT1201	Geometry	2
	MAT1202	Calculus-II	2
	MAT1203	Practical Based on MAT1201 & MAT1202	2

S. Y. B. Sc. Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
III	MAT2301	Multivariable Calculus-I	3
	MAT2302	Laplace Transform & Fourier Series	3
	MAT2303	Practical Based on MAT2301 & MAT2302	2
IV	MAT2401	Linear Algebra	3
	MAT2402	Multivariable Calculus-II	3
	MAT2403	Practical Based on MAT2401 & MAT2402	2

T.Y.B.Sc Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
V	MAT3501	Metric Spaces	3
	MAT3502	Real Analysis I	3
	MAT3503	Problem Course based on MAT3501 &MAT3502	2
	MAT3504	Group Theory	3
	MAT3505	Ordinary Differential Equation	3
	MAT3506	Problem Course based on MAT3504 &MAT3505	2
	MAT3507	Operation Research	3
	MAT3508	Number Theory	3
	MAT3509	Practical based on MAT3507 &MAT3508	2
VI	MAT3601	Complex Analysis	3
	MAT3602	Real Analysis II	3
	MAT3603	Problem Course based on MAT3601 & MAT3602	2
	MAT3604	Ring Theory	3
	MAT3605	Partial Differential Equation	3
	MAT3606	Problem Course based on MAT3604 & MAT3605	2
	MAT3607	Optimization Techniques	3
	MAT3608	Lebesgue Integration	3
	MAT3609	Practical based on MAT3607 & MAT3608	2
	MAT3610	Project	2

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Course Structure for F. Y. B. Sc. Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
I	MAT1101	Algebra	2
	MAT1102	Calculus-I	2
	MAT1103	Practical Based on MAT1101 & MAT1102	2
II	MAT1201	Geometry	2
	MAT1202	Calculus-II	2
	MAT1203	Practical Based on MAT1201 & MAT1202	2

SYLLABUS (CBCS) FOR F. Y. B. Sc. MATHEMATICS
(w.e.f. June, 2019)

Academic Year 2019-2020

Class **:** F.Y. B. Sc. (Semester- I)
Paper Code: MAT1101
Paper **:** I **Title of Paper :** Algebra
Credit **:** 2 **No. of lectures:** 36

A) Learning Objectives:

- Introduce the students with basic concepts in Mathematics such as sets, relations, equivalence relations and functions.
- To introduce different techniques of proving the theorems such as induction, proof by contradiction
- To introduce integers, complex numbers, and matrices as important examples to study different algebraic structures

B) Learning Outcome:

Use this algebraic structures & technique for further learning and problem solving in Mathematics.

TOPICS/CONTENTS:

Unit 01: Induction [*3 Lectures*]

1.1 Well ordering principle for natural numbers
1.2 Principle of Mathematical induction (Strong form)

Unit 02: Sets, Relations and Functions [*8 Lectures*]

2.1 Definition of set, Operation on sets, Power set, Cartesian product of sets.
2.2 Definition of relation, equivalence relation, equivalence classes, partition of a set.
2.3 Definition of function, domain, co-domain, and the range of function, injective, surjective, bijective functions, composite functions, invertible functions.

Unit 03: Integers [*6 Lectures*]

3.1 Divisibility, Division algorithm, Euclidean algorithm, Properties of G.C.D. and L.C.M.
3.2 Primes, Euclid's lemma, Unique factorization theorem (Statement only).
3.3 Congruences: Definition and elementary properties, Fermat's little theorem (Statement only).
3.4 Euler's phi-function.

Unit 04: Complex Numbers [*5 Lectures*]

4.1 Addition and multiplication of complex numbers, Modulus and amplitude of complex numbers, Real and imaginary parts and conjugate of complex numbers.
4.2 Geometric representation of sum, difference, product and quotient of two complex numbers as well as modulus, amplitude and conjugate.
4.3 De'Moivre's theorem, Roots of unity, Euler's formula.

Unit 05: Matrices and system of linear equations [*14 Lectures*]

5.1 Matrices, Row echelon and reduced row echelon form of a matrix, Rank of matrix.
5.2 System of linear equations, Matrix form of system of linear equations, Homogeneous and non-homogeneous system of linear equations, Gauss elimination, Gauss-Jordan methods.
5.3 Consistency of a system of linear equations, condition of consistency (Without proof).
5.4 Eigen values, Eigen vectors, Characteristic equation of a matrix.
5.5 Cayley Hamilton theorem (Statement only), Inverse of matrix.

Textbook:

1. David M. Burton, Elementary Number Theory, Tata McGraw Hill, 7th Edition, 2012. (**Sections:**1.1 , 2.1 to 2.4, 4.2, 5.2, 7.2, 7.3)
2. H. Anton,C. Rorres, Elementary linear algebra with applications, Wiley 7th Edition, 1994 (**Sections:**1.1 to 1.6, 6.1,9.1 to 9.3)
3. Kenneth Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill. (**Sections:** 2.1 to 2.3, 7.1 , 7.5)

Reference Books:

1. Tom M. Apostol, Calculus Volume – I, Wiley International Edition, 2007.
2. A Foundation Course in Mathematics , Ajit Kumar , S. Kumeareson , Bhaba Sarma
3. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 4th Edition, 2011.
4. Ruel V. Churchill, W. Brown, Complex Variables and Applications, Tata McGraw Hill, 9th Edition

Class : F.Y. B. Sc. (Semester- I)

Paper Code: MAT1102

Paper : II **Title of Paper :** Calculus I

Credit : 2 **No. of lectures:** 36

A) Learning Objectives:

- To introduce concepts of limit, continuity, differentiation
- To understand the behavior of functions increasing, decreasing, concave up, concave down ,which is crucial in many practical situation

B) Learning Outcome:

To apply these concepts for advance study in Mathematics (Real Analysis, Complex Analysis, topology) & as tools or applications in physical, chemical, biological sciences.

TOPICS/CONTENTS:

Unit 01: Introduction to Real Numbers: [15 lectures]

1.1 The Set $\mathbb{N}$ of Natural Numbers
1.2 The Set $\mathbb{Q}$ of Rational Numbers
1.3 The Set $\mathbb{R}$ of Real Numbers
1.4 The Completeness Axiom
1.5 The symbols $+\infty$ and $-\infty$

Unit 02: Sequences [18 lectures]

2.1 Limits of Sequences
2.2 A discussion about Proofs
2.3 Limit theorems for Sequences
2.4 Monotone Sequences and Cauchy Sequences
2.5 Subsequences
2.6 lim sup's and limit inf's

Unit 03: Series [3 lectures]

3.1 Introduction, Definition & examples , Partial Sums
3.2 Ratio Test (without proof)
3.3 Root Test (without proof)

Text Book:

Elementary Analysis (Second Edition), Kenneth A. Ross, Springer

Sections: 1 to 5, 7 to 12 &15

Reference Books:

1. A Course in Calculus and Analysis by Sudhir Ghorpade and BalmohanLimaye, Springer 2006.
2. Principles of Mathematical Analysis , W. Rudin, Third Edition, McGraw Hill, 1976
3. Mathematical Analysis , Tom M. Apostol.
4. Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert, Third Edition, John Wiley and Sons,2002

Class **:** F.Y. B. Sc. (Semester- I)

Paper Code: MAT1103

Paper **:** III **Title of Paper :** Practical Based on MAT1101 & MAT1102

Credit **:** 2 **No. of lectures:** 48

A) Learning Objectives:

Improve problem solving ability in relations , functions , congruence

Improve problem solving ability using properties of real numbers,sequences and series

B) Learning Outcome:

Lead students to learning and improving their understanding of the Mathematics

Title of Experiments:

Algebra:

1. Induction and complex numbers.
2. Relations and functions.
3. Divisibility and congruences.
4. Matrices: Determinant, rank, Eigen values and Eigen vectors, Cayley Hamilton theorem.
5. System of linear equations
6. Miscellaneous

Calculus I:

1. Real Numbers
2. Graphs and functions with & without using software Maxima
3. Sequence -I
4. Sequence-II
5. Series
6. Miscellaneous

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Course Structure for M.Sc.I Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
I	MAT4101	Real Analysis	4
	MAT4102	Advanced Calculus	4
	MAT4103	Group theory	4
	MAT4104	Numerical Analysis	4
	MAT4105	Ordinary Differential Equations	4
	MAT4106	Practical: Programming in C	4
II	MAT4201	Complex Analysis	4
	MAT4202	Topology	4
	MAT4203	Rings and Modules	4
	MAT4204	Linear Algebra	4
	MAT4205	Partial Differential Equations	4
	MAT4206	Practical: Programming in C++	4

Course Structure for M.Sc.II Mathematics

III	MAT5301	Combinatorics	4
	MAT5302	Field Theory	4
	MAT5303	Functional Analysis	4
	MAT5304	Graph Theory	4
	MAT5305	Applied Mathematics I	4
	MAT5306	Practical: Python	4
IV	MAT5401	Number Theory	4
	MAT5402	Differential Geometry	4
	MAT5403	Fourier Analysis	4
	MAT5404	Lattice Theory	4
	MAT5405	Applied Mathematics II	4
	MAT5406	Project	4

SYLLABUS (CBCS) FOR M.Sc.I MATHEMATICS
(w.e.f. June, 2019)

Academic Year 2019-2020

Class : M.Sc I (Semester- I)
Paper Code: MAT4101
Paper : I Title of Paper : Real Analysis
Credit : 4 No. of lectures: 60

A) Learning Objectives:

To expose the students to basic and advance concepts in real analysis such as metric spaces, measure theory, Fourier analysis

B) Learning Outcome:

To understand Real Analysis and apply it to theoretical and practical problems

TOPICS/CONTENTS:

1. Metric Spaces, Normed Spaces, Inner Product Spaces:
   Definitions and Examples, Sequence Spaces, Function Spaces, Dimensions.
2. Topology of Metric Spaces:
   Open, Closed and Compact sets, The Heine-Boral and Ascoli-Arzela' Theorems, Separability, Banach and Hilbert Spaces.
3. Measure and Integration:
   Lebesgue Measure on Euclidean Space, Measurable and Lebesgue Integrable Functions, The Convergence Theorems, Comparison of Lebesgue Integral with Riemann integral, General Measure and Lebesgue L^p-Spaces.
4. Fourier Analysis in Hilbert space:
   Orthonormal Sequence, Bessel's Inequality, Parseval's Theorem, Riesz-Fischer Theorem, Classical Fourier Analysis.
5. Weierstrass Approximation Theorem, Generalized Stone-Weierstrass Theorem, Baire Category Theorem and it's Applications, Contraction Mapping.

Text Book: *Beginning Functional Analysis*, Karen Saxe, Springer International Edition.

(Chapters: 1 to 4, 6.1, 6.2, 6.5)

Reference Books:

1. *Principles of Mathematical Analysis*, W. Rudin, Mc'Graw Hill.
2. *Topology of Metric Spaces*, S. Kumaresan, Narosa Publishing.
3. *Introduction to Topology and Modern Analysis*, G. F. Simmons, Mc'Graw Hill.

Class : M.Sc I (Semester- I)

Paper Code: MAT4102

Paper : II Title of Paper : Advanced Calculus

Credit : 4 No. of lectures: 60

A) Learning Objectives:

- To understand theory in Vector calculus
- To use important theorems such as Greens, Divergence, Stokes for problem solving

B) Learning Outcome:

To apply these concepts to solve practical problems arising in Physics and other related areas

TOPICS/CONTENTS:

1.Derivative of a scalar field with respect to a vector, Directional derivative, Gradient of a scalar field, Derivative of a vector field, Matrix form of the chain rule, Inverse function theorem and Implicit function theorem.

2.Path and line integrals, The concept of work as a line integral, Independence of path, The first and the second fundamental theorems of calculus for line integral, Necessary condition for a vector field to be a gradient.

3.Double integrals, Applications to area and volume, Green's Theorem in the plane, Change of variables in a double integral, Transformation formula, Change of variables in an n-fold integral.

4.The fundamental vector product, Area of a parametric surface, Surface integrals,The theorem of Stokes, The curl and divergence of a vector field, Gauss divergence theorem, Applications of the divergence theorem.

5.Applications of differential Calculus: Partial differential equations ,A first order partial differential equation with constant coefficients, The one Dimensional wave equation.

Text Book:

T. M. Apostol: Calculus, Vol. II (2nd edition) (John Wiley and Sons, Inc.)

Chapter 1: Sections 81 to8.22

Chapter 2: Sections 10.1 to 10.11 and 10.14 to 10.16

Chapter 3: Sections 11.1 to 11.5 and 11.19 to 11.22 and 11.26 to11.34

Chapter 4: Sections 12.1 to 12.15, 12.18 to 12.21

Chapter 5: Sections 9.1 to 9.5

(For Inverse function theorem and Implicit function theorem refer the book "Mathematical Analysis" by T. M.Apostol.)

Reference Books :

1. T. M. Apostol: Mathematical Analysis (Narosa publishinghouse)
2. W. Rudin: Principles of Mathematical Analysis (Mc-GrawHill)
3. A. Devinatz: Advanced Calculus, (Holt, Rinehart and Winston),1968

Class : M.Sc I (Semester- I)

Paper Code: MAT4103

Paper : III Title of Paper : Group Theory

Credit : 4 No. of lectures: 60

A) Learning Objectives:

- To understand abstract structures in Mathematics
- Understanding of theoretical part of Groups and how to use them to solve problems

B) Learning Outcome:

Use of Group Theory in solving problems of different of Mathematics such as Algebraic Topology, how Group Theory explains symmetry and hence have application in Physics, Chemistry and other subjects

TOPICS/CONTENTS:

1. Revision of definition and examples of groups, subgroups.
2. Cyclic Groups, Classification of subgroups of cyclic groups.
3. Permutation Groups
4. Isomorphism, Cayley's theorem, properties of isomorphisms, automorphism
5. Cosets and Lagrange's theorem. Orbit-stabilizer theorem, the rotation group of a cube and a soccer ball.
6. External Direct Products
7. Normal subgroups and factor groups, Internal direct products
8. Group Homomorphism
9. Fundamental theorem of finite abelian groups
10. Sylow theorems
11. Applications of Groups: Symmetries of square ,The dihedral groups. A check-digit scheme based on D_5 ,The rotation group of a cube and a soccer ball ,Data Security ,Public key cryptography.

Text Books: Joseph Gallian – Contemporary Abstract Algebra (Narosa Publishing House). Chapter 2 to 11, 24, 25.

Reference Books:

1. I.S. Luthar and I.B.S. Passi : Algebra (Volume 1) Groups (Narosa Publishing House)

2. I.N. Herstein : Topics in Algebra (Wiley -Eastern Ltd)

3. N.S. Gopala Krishnan : University Algebra (Wiley-Eastern Ltd)

4. Fraleigh : A First Course in Abstract Algebra

5. Dummit and Foote : Abstract Algebra (Wiley-Eastern Ltd)

6. Algebra, Artin.

Class : M.Sc I (Semester- I)

Paper Code: MAT4104

Paper : IV Title of Paper : Numerical Analysis

Credit : 4 No. of lectures: 64

A) Learning Objectives:

To solve problems numerically by various approximation methods

Use it solve problems in ODE and practical problems

B) Learning Outcome:

In real situations problems cannot be solve directly by available mathematical tools then use Numerical analysis to solve these problems with some error

TOPICS/CONTENTS:

1.Root of Nonlinear Equations: Introduction, Methods of Solution, Iterative methods, Evaluation of Polynomials, Bisection method, False Position method, Newton Raphson Method, Secant Method, Fixed Point Method, System of Nonlinear Equations, Roots of Polynomials

2.Direct Solution of Linear Equations: Existence of Solution, Solution by elimination, Basic Gauss Elimination method, Gauss elimination with pivoting, Gauss-Jordan Method, Triangular Factorization Methods, Round-off Errors and Refinement, Matrix Inversion Method

3.Iterative Solution of Linear Equations: Jacobi Iterative method, Gauss-Seidel Method, Convergence of Iteration Methods

4.Curve Fitting Interpolation: Polynomial forms, linear interpolation, Lagrange Interpolation Polynomial, Newton Interpolation Polynomial, Interpolation with equidistant points

5.Numerical Differentiation: Differentiating Continuous functions, Forward difference quotient, Central difference quotient, Error analysis

6.Numerical Integration: Newton-Cotes Methods, Trapezoidal Rule, Simpsons 1/3 rule, Simpsons 3/8 rule

7.Numerical Solution of Ordinary Differential Equations: Taylor Series Method, Euler's Method, Heun's Method, Polygon Method, Runge-Kutta Methods

8.Boundary-value and Eigenvalue Problems: Shooting Method, Finite Difference Method, Solving Eigenvalue Problems, Power method

Text Book: Numerical Methods, E Balagurusamy, Mc Graw Hill , Sections: 6.1-6.3, 6.5-6.10,7.1-7.8, 7.10,8.1-8.5,9.1-9.7,11.1,11.2,12.1-12.5,13.2-13.6,14.1-14.4,14.6

Reference Books:

1) S. S. Sastry, Introduction Methods of Numerical Analysis (4th Edition) Prentice
2) Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Prentice Hall 2007.
3) K .E. Atkinson: An Introduction to NumericalAnalysis.
4) J. I. Buchaman and P.R. Turner, Numerical Methods andAnalysis.
5) M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for scientific & Engineering Computation, 5th Edition New Age International Publication.

Class : M.Sc I (Semester- I)

Paper Code: MAT4105

Paper : V Title of Paper : Ordinary Differential Equations

Credit : 4 No. of lectures: 64

A) Learning Objectives:

- To understand theory of linear and nonlinear ODE
- To study methods to solve linear and nonlinear ODE
- To study applications of ODE

B) Learning Outcome:

Understanding of ODE and its applications to all Sciences as well as other real and practical problems

TOPICS/CONTENTS:

Review : General remarks on solutions of differential equations, Families of curves, Orthogonal trajectories.

1.Second Order Linear Equations:

The general solution of the homogeneous equations, Use of a known solution to find another solution,Homogeneous equations with constant coefficients. Themethod of undetermined coefficients. The method of variation of parameters.

2. Qualitative properties of solutions of Ordinarydifferential equations of order two :

Sturm Separation theorem. Normal form. Standard form, Sturm's comparison theorem.

3.Power Series Solutions and special functions:

Review of power series, Series solutions of first order equations, Second order linear equations. Ordinary points, Regular singular point, Indicial equations. Guass Hypergeometric equation. The point at infinity. Legendre polynomials, properties of Legendre polynomials, Bessel Functions, Properties of BesselFunctions.

4.Systems of First Order Equations:

General remarks on systems, Linear systems, Homogeneous linear system with constant coefficients.

5.The Existence and Uniqueness of solutions:

The method of successive approximations, Picards theorem, Existence and uniqueness of Second order initial value problems.

Text Book:

G. F. Simmons : Differential Equations with applications and Historical notes (Tata - McGraw Hill).

Sections: 1 to 3, 7 to 11, 14 to 19 , 24 , 25, 26 to 32, 54 to 57, 68 to 70

Reference Books

1. G. Birkhoff and G.C. Rota : Ordinary differential equations.

(John Wiley and Sons)

2. S. G. Deo, V. Lakshmikantham, V. Raghvendra. Text book of Ordinary Differential

Equations. Second edition.Tata Mc-Graw Hill.

3. E. A. Coddington : An Introduction to Ordinary Differential Equations
(Prentice Hall).

Class : M.Sc I (Semester- I)
Paper Code: MAT4106
Paper : VI
Title of Paper : Practical- Programming in C
Credit : 4 No. of lectures: 64

A) Learning Objectives:

- To understand basic programming in C
- To study mathematics using programming
- Use of Mathematics in programming

B) Learning Outcome:

To use programming to make useful software in industry and use of Mathematics in them makes them more reliable and user friendly

TOPICS/CONTENTS:

1. Introductory concepts in C
2. C Fundamentals
3. Operators and Expressions
4. Data input and outputs
5. Preparing and running a program
6. Control statements
7. Functions
8. Program Structures
9. Arrays
10. Pointers

Text Book:

Yeshwant Kanetkar, Let us C, BPB Publications

Reference Books :

i) Byron S. Gottfried, Programming with C, Schaum's Outline Series
ii) W.H.Press, S.A.Teukolsky et.al, Numerical recipes in C, The art of scientific computing

Anekant Education Society's
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Autonomous

Course Structure for B.Sc.(Computer Science) Mathematics

F. Y. B. Sc.(Computer Science) Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
I	CSMT1101	Graph Theory	2
	CSMT1102	Algebra	2
	CSMT1103	Mathematics Practical based on CSMT1101 & CSMT1102	2
II	CSMT1201	Discrete Mathematics	2
	CSMT1202	Calculus	2
	CSMT1203	Mathematics Practical based on CSMT1201 & CSMT1202	2

S. Y. B. Sc.(Computer Science) Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
III	CSMT2301	Linear Algebra	3
	CSMT2302	Numerical Analysis	3
	CSMT2303	Mathematics Practical I	2
IV	CSMT2401	Computational Geometry	3
	CSMT2402	Operations Research	3
	CSMT2403	Mathematics Practical II	2

SYLLABUS (CBCS) FOR F. Y. B. Sc.(COMPUTER SCIENCE)
MATHEMATICS
(w.e.f. June, 2019)

Academic Year 2019-2020

Class : F.Y. B. Sc.(Computer Science) (Semester- I)
Paper Code: CSMT1101

Paper : I **Title of Paper :** Graph Theory
Credit : 2 **No. of lectures:** 36

A) Learning Objectives:

- To introduce graphs, their types and properties
- To understand applications of graph theory in Computer science
- To build the necessary skill set and analytical abilities for developing computer based solutions using mathematical concepts

B) Learning Outcome:
Understanding of algorithms and applications to computer science

TOPICS/CONTENTS:

Unit 01: An Introduction to Graphs (12 lectures)

1.1 Definition of a Graph.
1.2 Graphs as a model
1.3 More definitions
1.4 Vertex Degrees
1.5 Subgraphs
1.6 Paths and Cycles
1.7 The Matrix Representation of Graphs
1.8 Fusion

Unit 02: Trees and Connectivity (12 lectures)

2.1 Definitions and Simple Properties
2.2 Bridges
2.3 Spanning Trees
2.4 Connector Problems
2.5 Shortest Path Problems
2.6 Cut Vertices and Connectivity

Unit 03: Euler Tours and Hamiltonian Cycles (7 lectures)

3.1 Euler Tours
3.2 The Chinese Postman Problem
3.3 Hamiltonian Graphs
3.4 Travelling Salesman Problem

Unit 04: Directed Graphs and Networks (5 lectures)

4.1 Definitions
4.2 Indegree and Outdegree
4.3 Flow and Cuts
4.4 Applications to Computer Science

Text Book:

John Clark and Derek Holtan , A First Look at Graph Theory, Allied Publishers
(Chapters: 1, 2, 3, 7 and 8)

Reference Books:

4. Kenneth Rosen, Discrete Mathematics and It's Applications,Tata McGraw Hill.
5. Narsingh Deo, Graph Theory with Application to Computer Science and Engineerng,Prentice Hall.

Class : F.Y. B. Sc.(Computer Science) (Semester- I)
Paper Code: CSMT1102

Paper : II **Title of Paper :** Algebra
Credit : 2 **No. of lectures:** 36

A) Learning Objectives:

- To understand properties and operations on sets and functions
- To understand basic concepts of groups, integers, matrices

B) Learning Outcome:

Improves problem solving ability and understanding of different algebraic structures in Mathematics

TOPICS/CONTENTS:

Unit 01:Set and Functions (5 lectures)

1.1 Definition of set, operations on sets, power set, Cartesian product of sets.
1.2 Definition of Function, Domain, Co-domain and the range of function, Injective, surjective and bijective functions, Composite function, invertible function.

Unit 02: Binary Operations and Groups (13 lectures)

2.1 Definition of binary operation, examples, properties of binary operation.
2.2 Definition of Monoid, semi group, examples.
2.3 Definition of Group and examples, subgroups, finite and infinite groups, cyclic groups.
2.4 Applications to Computer Science.

Unit 03: Integers (9 lectures)

3.1 Well ordering principle.
3.2 First and Second Principle of Mathematical Induction ,Examples.
3.3 Division Algorithm (Without Proof)
3.4 Divisibility and its Properties, prime numbers.
3.5 Definition G.C.D and L.C.M , Expressing G.C.D. of two integers as a linear combination of the two integers.
3.6 Euclidean Algorithm (Without Proof)
3.7 Relatively prime integers , Euclid Lemma and its generalization.
3.8 Congruence relations and its properties, Residue Classes: Definition, Examples, addition and multiplication modulo n and composition tables.
3.9 Euler's and Fermat's Theorems.(Without Proof). Examples.
3.10 Applications to Computer Science.

Unit 04: Matrices and System of linear Equations (9 lectures)

4.1 Revision: Elementary operations on matrices.
4.2 Echelon form of matrix.
4.3 System of linear Equations:
4.4 Gauss Elimination Method,
Gauss Jordan Elimination Method,
L.U. Decompositions Method.
4.5 Rank of matrix, Row rank, Column rank.
4.6 Applications to Computer Science.

Text Books: Unit 01: Set & Functions (Kenneth Rosen, Discrete Mathematics and It's Applications,Tata McGraw Hill).**Section : 2.1 to 2.3**

Unit 02: Binary Operations and Groups(J. B. Fraleigh, A. First Course in Abstract . Algebra,Third Ed., Narasa, New Delhi 1990).**Chapter 1 .Section : 1,2,4,5,6.**

Unit 03: Integers (David M. Burton,Elementary Number Theory**) Section: 1.1,2.1 to 2.4 , . 4.2,5.2,7.2,7.3**

Unit 04: Matrices and System of linear Equations(Kwak & Hong ,Linear Algebra**) . .. Section: 1.1 to 1.4 ,1.6 to 1.9** .

Reference Books:

1. 1. Discrete Mathematics Structure- Bernard Kolman, Robert Busby, Sharon Culter Ross, Nadeem-ur-Rehman , Pearson Education, 5th Edition.
2. Elements of Discrete Mathematics – C. L. Liu, Tata McGraw Hill.
3. J. B. Fraleigh, A. First Course in Abstract Algebra, 7th Edition,Pearson
4. H. Anton, C. Rorres, Elementary linear algebra with applications, Wiley 7th
   i. Edition,1994.

Class : F.Y. B. Sc.(Computer Science) (Semester- I)

Paper Code: CSMT1103

Paper : III **Title of Paper** : Practical based on CSMT1101 & CSMT1102

Credit : 2 **No. of lectures:** 48

A) Learning Objectives:

- Problem solving ability and understanding applications of Graph Theory
- Improve skills to handle abstract algebraic structures such as integers, groups

B) Learning Outcome:

Lead students to apply these mathematical concepts in the study of computer science

Title of Experiments:

Graph Theory:

7. Graphs and Operations on Graphs.
8. Connected Graphs.
9. Eulerian and Hamiltonian Graphs.
10. Trees.
11. Directed Graphs.
12. Miscellaneous

Algebra:

1. Relations and functions.
2. Binary Operations
3. Groups
4. Divisibility and Congruence
5. Matrices and System of linear Equations
6. Miscellaneous