Enclosure - I

SARVODAYA KELAVANI SAMAJ MANAGED,

SHREE MANIBHAI VIRANI & SMT.NAVALBEN VIRANI SCIENCE COLLEGE

AN AUTONOMOUS COLLEGE- AFFILIATED TO SAURASHTRA UNIVERSITY, RAJKOT

Re-accredited at the 'A' Level (CGPA 3.28) by NAAC
'STAR' College Scheme & Status by MST-DBT
A College with Potential for Excellence - CPE (Phase-II) by UGC
Accredited at the G-AAA Highest Grade 'A-1′ Level by KCG, Govt. of Gujarat
UGC-DDU KAUSHAL Kendra
GPCB-Government of Gujarat approved Environment Audit Centre

DEPARTMENT OF MATHEMATICS

SYLLABUS FOR THE COURSES OF THE 5TH AND 6TH SEMESTER

OF

B.Sc. Mathematics

B.Sc. Mathematics

For students admitted from A.Y. 2016-2017 & onwards

SEMESTER – V			
16UMTCC18	**CORE 10 :** Programming in C	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Analyze given mathematical problem to solve it using a computer program.
2. Develop algorithm to solve given mathematical problem using C program.
3. Write program to solve given mathematical problem using it.
4. Find errors in the C program and correct it.

Unit 1: Introduction to C **(8hrs)**

- History of C, C character set
- Constants, Variables, Keywords, Type Declaration, Type Conversion
- Hierarchy of operators
- printf & scanf functions
- Simple programs using these basic concepts.

Unit 2: Decisions and Branching **(7hrs)**

- if statement, if-else statements
- Nested if-else, elseif clause
- Logical operators, Conditional operators
- Programs using these concepts

Unit 3: Looping Mechanism and User Defined Functions **(7hrs)**

- While loop, for loop
- do-while loop, break statement
- Continue statement goto statement
- Brief introduction to User Defined Functions
- Programs using these concepts

Unit 4: Data types and Preprocessor **(7hrs)**

- Data types in C Integers: long and short types
- signed and unsigned characters, Signed and unsigned
- float and doubles
- C processors, meaning
- Macro Expansion
- Macros with Arguments
- Programs using these concepts

Unit 5: Introduction to Arrays **(7hrs)**

- Arrays, meaning:
- One dimensional and two dimensional
- Declaration and initialization of one dimensional and two dimensional arrays
- Use of one dimensional and two dimensional arrays in simple programs

TEXT BOOKS: -

1. Yashvant Kanetker, LET US C, 5th Edition, BPB Publications, New Delhi.
2. E. Balagurusamy, Programming in ANSI C, McGrew Hill Education, Seventh Edition.

REFERENCE BOOKS:-

1. Brian W. Karnighan and Dennis M. Ritchie, The ANSI C Programming Language, Prentice Hall, 1988.
2. V. Rajaraman, Computer Programming in C, Prentice Hall of India, 1994.

Semester – V			
16UMTCC19	**CORE 11:** Group Theory	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand the basic ideas and notions of abstract algebra.
2. Define and recognize the abstract mathematical structures including group and subgroups.
3. State and criticize the properties of groups.
4. Define and recognize the Isomorphism of groups and Homomorphism of groups.
5. Define of Permutation groups and cyclic groups and prove theorems of the same.

Unit 1: Introduction to Group **(6 hrs)**

- Definition and examples of Groups.
- Elementary Properties of Group.
- Finite group, Order of a group, Order of an element.

Unit 2: Subgroups and Normal Subgroups **(7 hrs)**

- Definition and example of a subgroup.
- Lagrange's Theorem.
- Definition of Centre of a Group and theorems related to it.
- Definition and example of a Normal subgroup.
- Theorems related to Normal Subgroup.

Unit 3: Permutation Groups and Cyclic Group **(8 hrs)**

- Definition and examples of Permutation Groups.
- Transposition and Cycle.
- Properties of Cyclic Group.
- Classification of Subgroup of Cyclic Group.

Unit 4: Isomorphism of Groups **(7 hrs)**

- Definition and Examples
- Cayley's Theorem
- Properties of Isomorphism.
- Automorphisms and Inner Automorphisms.

Unit 5: Group Homomorphism **(7 hrs)**

- Definition and Examples
- Properties of Homomorphisms
- Kernal of Homomorphism
- The First Isomorphism Theorem

TEXT BOOKS: -

1. I.H.Sheth, Abstract Algebra, Prentice/Hall of India Private Limited, New Delhi
2. I. N. Herstein, Topics in Algebra, Vikas Publishing, New Delhi.

REFERENCE BOOKS:-

1. Thomas W. Judson, Abstract Algebra Theory and Applications, Stephen F. Austin State University, 2009.
2. Marlow Anderson & Todd Fel, A first course in Abstract Algebra (Rings, Groups & fields), Chrpman & Halilereivy
3. Fraleigh J.B., A First Course in Abstract Algebra, Narosa Publishing, New Delhi.
4. Joseph A. Gallian, Contemporary Abstract Algebra, Forth Edition, Narosa Publishing House.

Semester – V			
16UMTCC20	**CORE 12:** Numerical Analysis - **I**	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Analyze data and find proper curves to fit the data given.
2. Understand the meaning of roots and find the roots of given equations including Equation with Rational Coefficients and Irrational Roots.
3. Solve and criticize Simultaneous Linear Algebraic Equation.
4. Find finite differences and utilize the same to do interpolation of given data.

Unit 1: Empirical Laws and Curve Fitting **(8 hrs)**

- Introduction.
- Linear Law.
- Laws reducible to linear law
- Principle of Least Squares.
- Fitting a Straight Line.
- Fitting a Parabola.
- Fitting an Exponential Curve.
- Fitting the curve $y = ax^b$.

Unit 2: Theory of Equation. **(8 hrs)**

- Introduction.
- Relation between Roots and Coefficients.
- Equation with Real Coefficients and Imaginary Roots.
- Equation with Rational Coefficients and Irrational Roots.
- Symmetric Function of Roots.
- Formation of Equation whose Roots are Given.
- Transformation of Equation.
- Multiple Roots.

Unit 3: Simultaneous Linear Algebraic Equation. **(6 hrs)**

- Introduction.
- Gauss elimination method.
- Gauss Jordan method.
- Method of factorization (L.U. Decomposition).
- Crout's method.
- Jacobi's method.
- Gauss Seidal's method.

Unit 4: Finite Differences. **(8 hrs)**

- Introduction.
- Finite differences (forward , backward and central).
- Differences of polynomials.

- Factorial polynomial.
- Reciprocal Factorial polynomial.
- Polynomial factorial notation.
- Error propagation in difference table.
- Other difference operators (Shift, averaging, differential and unit) and relation between them.

Unit 5: Interpolation with Equal Intervals. (6 hrs)

- Introduction.
- Gregory- Newton forward interpolation formula.
- Gregory- Newton backward interpolation formula.
- Equidistance terms with one or more missing values.

TEXT BOOKS: -

1. Numerical methods by Dr. V. N. Vedamurthy & Dr. N. Ch. S. N. Iyengar, Vikas Publishing house.

REFERENCE BOOKS:-

1. Introduction to Numerical Analysis (2nd Edition) by C.E.Froberg Addision Wasley, 1979
2. Numerical method, Problems & Solutions, by M. K. Jain, S. R. K.Iyengar, R. K. Jain, New Age International Pvt. Ltd., 1996.
3. Numerical Mathematical Analysis, by J. B.Scarforough, Oxford & IBH Publication. Co. Pvt. Ltd., 1966

Semester – V			
16UMTDC21	**Core 13:** Set Theory and Logic **(Self Study Course)**	**1 hrs/week**	**4 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Analyze the logical structure of statements symbolically, including the proper use of logical connectives, predicates, and quantifiers.
2. Construct truth tables, prove or disprove a hypothesis,
3. Evaluate the truth of a statement using the principles of logic.
4. Solve problems and write proofs using the concepts of set theory, including the methods of Venn diagrams and truth tables.

Unit 1: Sets and Basic Operations on Sets **(3 hrs)**

- Preliminaries: Basic set theory terminology and notation
- Venn Diagrams
- Classes of sets and power set
- Set operations
- Mathematical Induction
- Real Number System R
- Order and Inequalities, Absolute value, Distance, Intervals
- Bounded sets
- Integers Z, Greatest Common Divisor

Unit 2: Cardinal and Ordinal Numbers **(2 hrs)**

- Denumerable and Countable sets
- Cardinal Numbers, Ordering of Cardinal Numbers, Cardinal Arithmetic
- Well Ordered sets
- Ordinal Numbers, Structure of Ordinal Numbers.

Unit 3: Relations and Functions **(3 hrs)**

- Product set, Relations-introduction
- Composition of relation, Types of relation
- Functions-Introduction
- Composition of functions
- One to one, onto and invertible function
- Mathematical functions, exponential, logarithmic function

Unit 4 : Further theory of sets and functions **(2 hrs)**

- Operations of Collections of sets
- Indexed of Collections of sets
- Sequences, Summation symbol
- Fundamental Products
- Functions and Diagrams
- Special kinds of functions, Fundamental Factorization
- Choice function

- Algorithms and functions
- Complexity of Algorithms

Unit 5: Logic and Truth Tables (2 hrs)

- Logic propositions: Truth and falsehood of propositions,
- logic operations
- Tautologies and Contradictions
- Logical equivalence, Equivalences for negations, Equivalent forms of the implications
- Circuits and Logic
- The statement T and F

TEXT BOOKS: -

1. Set Theory and Logic, Robert R. Stoll, Dover Publications, New York, 1963.
2. Introduction to Set Theory, Karel Hrbacek and Thomas Jech, Marcel Dekker, 1999.

REFERENCE BOOKS:-

1. A Course on Set Theory, Ernest Schimmerling, Cambridge University Press, 2011.
2. Set Theory and Related Topics, 2nd edition, Seymour Lipschutz, Schaum's Outline Series, Mc Graw Hill, 1988.

Semester – V			
16UMTDC01	**DSE – CORE 1:** Metric Space	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand the concept of metric space and its structure.
2. Determine closed-ness of the given set with respect to given metric.
3. Discuss and criticize the properties of Countable sets and Cantor set.
4. Evaluate and determine the compactness of the given sets in a metric space.
5. Analyze and criticize the connectedness of sets in metric space.

Unit 1: Metric space **(7 Hrs)**

- Metric Space – definition and problems based on it
- Usual Metric Space and Discrete Metric Space
- Problems based on Discrete Metric Space
- Some important results based on Discrete Metric Space.
- Neighbourhood , Interior point , Open set
- Problems based on Open set and Neighbourhood
- Hausdorff Principle
- Open sets in metric space
- Neighbourhood as an Open set
- Open interval as an open set

Unit 2: Closed Set **(6 Hrs)**

- Limit point, Closed set , Derived set, Dense set , Nowhere Dense
- Problems based on Closed set, derived set
- Results based on Closed set
- Boundary points of a set and problems based on it
- Results based on closure of a set

Unit 3: Countable set and Cantor set **(7 Hrs)**

- Fundamentals of one-one function and onto function
- Definition of Similar sets
- Problems based on similarity of sets
- Countable sets and problems based on Countable set
- Definition of the Cantor set
- Some important properties of the Cantor set
- Representation of Real number or m- based expression

Unit 4: Compact set **(8 Hrs)**

- Separated set in a metric space
- Difference between disjoint & Separated set
- Definition and examples of Cover of a set
- Definition and examples of Sub cover , Open cover
- Compact sets
- Some important results of Compact set

- Heine Boral Theorem
- Problems based on these concepts

Unit 5: Connected set **(7 Hrs)**

- Connected set
- Some important results based on Connected set
- Boltzano weirstrass theorem
- Nested Interval Theorem
- Totally Bounded sets
- Sequential Compactness
- Results based on Sequential Compactness
- Problems based on these concepts.

TEXT BOOKS: -

1. J. N. Sharma and A. R. Vashishtha , Mathematical Analysis - I , Krishna Prakashan Mandir , MEERUT(U.P.)
2. J. N. Sharma and A. R. Vashishtha , Mathematical Analysis - II , Krishna Prakashan Mandir , MEERUT(U.P.)

REFERENCE BOOKS:-

1. S.C.Malik & Savita Arora , Mathematical Analysis , New Age Int. Pvt.Ltd .
2. Shantinarayana , A first course of Mathematical Analysis , S. Chand & sons.
3. Tom.M.Apostol , Mathematical Analysis , Narosa Publishing House.
4. R.R.Goldberg , Methods of Real Analysis , Oxford & IBH Publishing Co. Pvt. Ltd.
5. H. L. Royden , Real Analysis , Prentice Hall of India Pvt Ltd. New Delhi.

Semester – V			
16UMTDC02	**DSE-CORE 1:** Number Theory	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Prove results involving divisibility and greatest common divisors;
2. Solve systems of linear congruences;
3. Find integral solutions to specified linear Diophantine Equations;
4. Apply Euler-Fermat's Theorem to prove relations involving prime numbers;
5. Apply the Wilson's theorem.

Unit 1. Introduction: (7 Hrs)

- Algebraic operations with integers,
- Well Ordering Principle, Pigeon Hole Principle, Principle of Mathematical Induction,
- Divisibility and division algorithm,
- Representation of integers in different bases, The greatest Common Divisor,
- The Euclidean Algorithm (without proof), Lame's theorem.

Unit 2. Prime Numbers: (6 Hrs)

- Prime and composite number,
- Fundamental Theorem of Arithmetic (without proof), canonical form of a number, the Sieve of Eratosthenes, Least Common Multiples,
- Linear Diophantine Equations-The function [x] and the "O" and "o" symbols,
- Theory of Congruence: Definition and basic properties of congruence,
- Residue class & complete system of residues,

Unit 3. Congruences: (8 Hrs)

- Introduction to congruences, Residue system,
- Euler's phi- function, Linear congruences, The Chinese Remainder Theorem,
- Theorems of Fermat, Euler and Wilson, problems on Euler's theorem.

Unit 4. Multiplicative Number theoretic Functions: (7 Hrs)

- Definitions and properties, The Euler phi function,
- The Sum of Divisors function,
- The Number of Divisors functions,
- The Mobius function, the Mobius inversion formula,
- The Perfect, Mersenne, and Fermat Numbers.

Unit 5. Primitive roots: (7 Hrs)

- The order of integers and primitive roots,
- Primitive roots for prime,
- Existence of primitive roots.

TEXT BOOKS: -

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

REFERENCE BOOKS:-

1. An introduction to the Theory of numbers - Niven and Zuckerman, Wiley Eastern Ltd.
2. Elementary Number Theory - Gareth A. Jones & J. Mary Jones, Springer Verlag.
3. Elementary Theory of Numbers - C. Y. Hsiung, Allied Publishers Ltd.-India.
4. Introduction to the theory of Numbers - G. H. Hardy & E. M. Wright, Oxford Uni. Press .

Semester – V			
16UMTDC03	**DSE- CORE - I :** Mechanics	**3 hrs/week**	**3 Credits**

Objectives:
Upon completion of the course students will be able to

1. Understand and describe elementary principles of motion.
2. Understand and criticize equations of motion and classify the dynamical systems.
3. Derive and utilize Lagrange's equation of motions.
4. Identify, understatnd and solve two body central force problem.

Unit 1 Methods of plane statics: (7hrs)

- Equilibrium of a particle and a system of particles, work and potential energy.
- Application of plane statics.

Unit 2 Mass centers and centers of gravity (7hrs)

- Mass centers and centers of gravity, friction flexible cables.
- Plane kinematics of a particle, motion of a rigid body parallel to a fixed plane.

Unit 3 Methods of plane dynamics : (7hrs)

- Motion of a particle motion of a system
- Projectiles without resisitance
- Harmonic oscillators

Unit 4 (7hrs)

- General motion under a central force
- Planetary orbits

Unit 5 (8Hrs)

- Motion of a rigid body and of a system
- Moments of Inertia
- Kinetic energy and angular momentum
- Rigid body rotation about a fixed axis
- General motion of a rigid body parallel to fixed plane
- Stability of equilibrium
- General theory of plane impulsive motion, collisions

TEXT BOOKS: -

1. Jhon L. Synge and Byron A. Griffith, Principles of Mechanics, McGrew Hill, Second Edition.
2. R. G. Takwale, P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill Education, 1979

REFERENCE BOOKS:-

1. H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House
2. C. R. Mondal, Classical Mechanics, Prentice Hall of India Pvt. Ltd.

Semester – V			
16UMTCC22	**CORE PRACTICAL-9 :** Programming in C Practical	**4 hrs/week**	**2 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Analyze given mathematical problem to solve it using a computer program.
2. Develop algorithm to solve given mathematical problem.
3. Write C program to solve given mathematical problem using the program.
4. Find errors in the C program and correct it.

List of Experiments

1. Write a program to find area of a circle when radius is given.
2. Write a program to calculate the area of a triangle when base and height of the triangle are given.
3. Write a program to find value of one number raised to another number.
4. Write a program to determine whether given number is an even or odd number.
5. Write a program to find largest of three given numbers.
6. Write a program to find largest of four given numbers.
7. Write program to find net salary when basic salary and other required details are given.
8. Write a program to solve the quadratic equation
9. Write a program to reverse an integer with FIVE digits.
10. Write a program to verify a number whether it is palindrome or not.
11. Write a program to find sum of the digits an integer with FIVE digits.
12. Write a program to print Armstrong numbers between1 to 999.
13. Write a program to generate arithmetic and geometric progressions.
14. Write a program to find nPr and nCr for given value of +ve integers n and r.
15. Write a program to find compound interest for given years.
16. Write a program to find number of odd number and even numbers.
17. Write a program to find factorial of a given number.
18. Write a program using UDF with two arguments and a return value.
19. Write a program that utilizes a UDF two find prime numbers between two integers entered through key-board.
20. Write a program to solve the equation by N-R method. (Use of preprocessor)
21. Write a program to find value determinant of a 2X2 and a 3X3 matrix.
22. Write a program to find inverse of a 2X2 matrix.
23. Write a program to find diagonal of a 3X3 matrix entered through key-board.
24. Write a program to find the sum, deference, and multiplication of two 3X3 matrices entered through key-board.

TEXT BOOKS: -

1. Yashvant Kanetker, LET US C, 5th Edition, BPB Publications, New Delhi
2. E. Balagurusamy, Programming in ANSI C, McGrew Hill Education, Seventh Edition.

REFERENCE BOOKS:-

1. Brian W. Karnighan and Dennis M. Ritchie, The ANSI C Programming Language, Prentice Hall, 1988.
   V. Rajaraman, Computer Programming in C, Prentice Hall of India, 1994.

Semester – V			
16UMTCC23	**CORE PRACTICAL 10:** Numerical Analysis - I Practical	**4 hrs/week**	**2 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Analyze data and find proper curves to fit the data given.
2. Understand the meaning of roots and find the roots of given equations including Equation with Rational Coefficients and Irrational Roots.
3. Solve and criticize Simultaneous Linear Algebraic Equation.
4. Find finite differences and utilize the same to do interpolation of given data.

List of Experiments

1. Gauss elimination method.
2. Gauss Jordan method.
3. LU decomposition method.
4. Crout's method.
5. Jacobi's method.
6. Gauss Seidel method.
7. Fitting a Straight line.
8. Fitting an exponential curve $y = e^{ax}$.
9. Fitting a Parabola.
10. Fitting the curve of the type $y = ax^b$.
11. Finite differences.
12. Gregory- Newton forward interpolation formula.
13. Gregory- Newton backward interpolation formula.
14. Equidistance terms with one or more missing values.

TEXT BOOKS: -

1. Numerical methods by Dr. V. N. Vedamurthy & Dr. N. Ch. S. N. Iyengar, Vikas publishing house.

REFERENCE BOOKS:-

1. Introduction to Numerical Analysis (2nd Edition) by C.E.Froberg Addision Wasley, 1979.
2. Numerical method, Problems & Solutions, by M. K. Jain, S. R. K.Iyengar, R. K. Jain, New Age International Pvt. Ltd., 1996.
3. Numerical Mathematical Analysis, by J. B.Scarforough, Oxford & IBH Publication. Co. Pvt. Ltd., 1966.

Semester – V			
16UMTCC24	**CORE PRACTICAL 11:** Advanced SCILAB Practical	**4 hrs/week**	**2 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand the concept of open source mathematical software including SCILAB.
2. Understand and utilize the user interface of SCILAB including console, file browser, variable browser, the command history and general commands including clc & clear
3. Utilize pre-defined mathematical constants and variables, operators of Scilab, Input and utilize inbuilt matrix commands including ones(), zeros(), eye(), spac(), diag(), inv(), det(), spec().
4. Solve problems using direct and iterative methods of numerical analysis with scilab.
5. Find and analyze the sub matrices of given matrices

List of Experiments

1. To get understand and utilize the program editor SCINOTE and its interface with small programs.
2. To create programs in SCINOTE understand usage of commands including clear, clear all, clf, clc,. etc.
3. To find the inverse of a matrix using GAUSS-ELIMINATION method.
4. To find inverse of given matrix using GAUSS-JORDAN method.
5. To find Eigen values and Eigen vectors of given matrix.
6. To find inverse of given matrix using CAYLEY-HAMILTON theorem.
7. To solve given system of simultaneous linear algebraic equations using GAUSS-JORDAN method.
8. To solve given system of simultaneous linear algebraic equations using GAUSS-JACOBI method.
9. To solve given system of simultaneous linear algebraic equations using GAUSS-SEIDAL'S method.
10. Introduction to variables and input statement in SCILAB, Introduction to the loop structure of SCILAB.

TEXT BOOKS: -

1. Scilab Group, SCILAB REFERENCE MANUAL, On-line Documentation, INRIA Meta2 Project / ENPC Cergrene, INRIA.

REFERENCE BOOKS:-

1. Vinu V. Das, Programming in Scilab, New Age International (P) Limited, 2008.
2. Domaine de Voluceau - Rocquencourt – B, INTRODUCTION TO SCILAB Consortium SCILAB, November 2010.
3. Gilberto E. Urroz, Programming with SCILAB, September 2002.
4. Tejas Sheth, SCILAB: A Practical Introduction to Programming and Problem Solving, 25 August 2015.

5. Perrine Mathieu, Philippe Roux, Scilab, from theory to practice, Scilab: I. Fundamentals, 2016, ISBN: 978-2-8227-0293-5.
6. Dr. M. Affouf, Scilab by example, 2012, ISBN: 978-1479203444

Websites:-

1. http://www.scilab.org/	Main website of Scilab
2. http://www.scilab.org/support/documentation	Official documentation of Scilab
3. http://www.scilab.org/products/scilab/download	Download Scilab software
4. http://help.scilab.org/docs/5.4.0/en_US/	Help on Scilab
5. http://ekalavya.it.iitb.ac.in/contents.do?topic=Scilab	IIT, Bombay portal
6. http://spoken-tutorial.org/Study_Plans_Scilab/	Spoken-tutorial
7. http://scilab.in/	Scilab India

Semester – VI			
16UMTCC26	**CORE 15:** Ring Theory	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand the basic ideas and notions of abstract algebra.
2. Define and recognize the abstract mathematical structures including Rings and sub-rings.
3. State and criticize the properties of Rings.
4. Define and recognize the Ideals of given Rings.
5. Define and recognize the homomorphism of rings and utilize its properties.

Unit 1: Ring **(7 Hrs)**

- Definition and examples of Ring
- Properties of Ring
- Further examples of Rings

Unit 2:Integral Domains **(6 Hrs)**

- Definition and example of Integral Domain
- Zero divisors
- Characteristic of a Ring
- Solution of the Equation ax=b in a ring R
- Theorems on Integral Domain

Unit 3: Ideals **(8 Hrs)**

- Definition of Subring
- Definition of Ideals
- Quotient Ring
- Theorems on Ideals and Its Examples

Unit 4: Homomorphism **(7 Hrs)**

- Definition and examples of a Ring homomorphism
- Properties of Ring Homomorphism
- Homomorphism and Characteristic
- Examples of Ring Homomorphism

Unit 5: Polynomial Ring and Introduction to Field **(8 Hrs)**

- Definition and Examples of Polynomial Ring
- Definition and Examples of Field
- Reducible and irreducible polynomials, Factorization of polynomials
- G.C.D. of polynomials, Quaternion

TEXT BOOKS: -

1. I. H. Sheth, Abstract Algebra, Prentice/Hall of India Private Limited, New Delhi.
2. I. N. Herstein, Topics in Algebra, Vikas Publishing, New Delhi.

REFERENCE BOOKS:-

1. Thomas W. Judson, Abstract Algebra Theory and Applications, Stephen F. Austin State University, 2009.
2. Marlow Anderson & Todd Fel, A first course in Abstract Algebra (Rings, Groups & fields), Chrpman & Halilereivy.
3. Fraleigh J.B., A First Course in Abstract Algebra, Narosa Publishing, New Delhi. Joseph A. Gallian, Contemporary Abstract Algebra, Forth Edition, Narosa Publishing House.

SEMESTER – VI			
16UMTCC27	**CORE 16 :** Optimization	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand the importance and scope of the subject Operations Research.
2. Develop and formulate problems in mathematics terms from given real life problems.
3. Solve linear programming problems with the methods including Simplex Method.
4. Solve Transportation Problems, Assignment Problems and Sequencing Problems.
5. Understand, analyze and effectively solve the problems related to the theory of games.

Unit 1: Introduction to Operations Research (7 Hrs)

- History and development of Operations Research
- Applications and scope of Operations Research
- The linear programming problems
- Formulation of LPP
- Matrix form of the LPP
- General form, Canonical form
- Standard form of the LPP
- Graphical method to solve LPP
- Some definitions and basic properties of convex sets
- Convex functions and concave function.

Unit 2: Linear Programming Problems (7 Hrs)

- Basic definitions to use Simplex method
- Simplex method (algorithm) to solve LPP
- Big-M method (Penalty method) to solve LPP
- Two phase method to solve LPP
- Problems of LPP based on these methods

Unit 3: Duality in LPP and Assignment problems (7 Hrs)

- Principle of duality in LPP
- Primal LPP and method to find its dual LPP
- Simple problems of duality.
- Mathematical and matrix form of Assignment Problem
- Hungarian method to solve Assignment Problem
- Problems of Assignment and its solution based on this method.

Unit 4: Transportation Problems (7 Hrs)

- The Transportation Problems
- Mathematical and matrix form of TP.
- Initial solution of TP by NWCM, LCM and VAM
- Optimum solution of TP by MODI method (u-v method) (except degenerate solution),
- Balanced and unbalanced TP (Simple problem)

Unit 5: Sequencing and Game Theory (8 Hrs)

- Introduction to Game Theory
- Two person zero-sum game
- Minimax and maximin principles
- Saddle point of a game
- Games without a saddle point
- Solution of games by dominance rule.
- Iterative method to solve a game
- Introduction to Sequencing Problems
- Terminology Notations and Assumptions
- Processing n-jobs through two machines
- Processing n-jobs through three machines.

TEXT BOOKS: -

1. J. K. Sharma, Operations Research (theory and Applications), MacMillan Publishing House .
2. R. K. Gupta, Operations Research, Krishna Prakashan Mandir, Meeut.

REFERENCE BOOKS:-

1. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
   Kanti Swaroop and Manmohan, Operations Research, Sultanchand and Sons.

Semester – VI			
16UMTCC28	**CORE 17:** Numerical Analysis - II	**3 hrs/week**	**3 Credits**

Objectives: -

Upon completion of the course students will be able to

1. Understand the concept of interpolation.
2. Analyze and process data with equal or unequal interval and interpolate the same for given non-tabulated values.
3. Perform numerical differentiation using various formulae including Gregory-Newton's forward difference formula and Sterling's formula.
4. Perform numerical integration using various formulae including Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule.
5. Solve ordinary differential equations numerically using method including Taylor's series method, Picard's method, Euler's method, Runge's method and Runge-Kutta methods.

Unit 1: Central difference interpolation formulae. (8 hrs)

- Introduction.
- Gauss's forward interpolation formula.
- Gauss's backward interpolation formula.
- Sterling's formula.
- Bessel's formula.
- Laplace- Everett's interpolation formula.

Unit 2: Interpolation with unequal intervals. (8 hrs)

- Introduction.
- Divided differences.
- Properties of divided difference.
- Relation between divided differences and forward difference.
- Newton's divided difference formula.
- Lagrange's interpolation formula.
- Inverse interpolation.
- Lagrange's inverse interpolation formula.

Unit 3: Numerical Differentiation. (6 hrs)

- Introduction.
- Numerical Differentiation.
- Derivatives using Gregory-Newton's forward difference formula.
- Derivatives using Gregory-Newton's backward difference formula.
- Derivative using Sterling's formula.

Unit 4: Numerical Integration. (6 hrs)

- Introduction.
- Numerical Integration.
- General quadrature formula.
- Trapezoidal rule.

- Simpson‘s 1/3 rule.
- Simpson’s 3/8 rule.

Unit 5: Numerical solution of ordinary differential equations. (8 hrs)

- Introduction.
- Solution by Taylor’s series method.
- Picard’s method.
- Euler’s method.
- Runge’s method
- Runge-Kutta methods.
- Higher order Runge-Kutta methods.

TEXT BOOKS: -

1. Numerical methods by Dr. V. N. Vedamurthy & Dr. N. Ch. S. N. Iyengar, Vikas Publishing house.

REFERENCE BOOKS:-

1. Introduction to Numerical Analysis (2nd Edition) by C.E.Froberg Addision Wasley, 1979.
2. Numerical method, Problems & Solutions, by M. K. Jain, S. R. K.Iyengar, R. K. Jain, New Age International Pvt. Ltd., 1996**.**
3. Numerical Mathematical Analysis, by J. B. Scarforough, Oxford & IBH Publication. Co. Pvt. Ltd., 1966.

Semester – VI			
16UMTDC04	**DSE-CORE 2:** Graph Theory	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand the fundamental concepts in graph theory.
2. Understand the types of a graph and incidence relation.
3. Define subgraph, connected and disconnected graphs. Understand walk, paths, circuits and Define tree and some properties of tree.
4. Define cut-set, connectivity and separability. Define planner graphs and their dual graphs. State and prove Kuratowski's first and second non-planner graph. Define vertex coloring, chromatic number and matrix representation of graphs.
5. Apply the concepts of graph theory in a variety of fields.
6. Understand and to construct mathematical proofs involving graphs.

Unit 1: Introduction **(8 hrs)**

- Basic definitions and simple examples.
- Directed, Undirected, multi-graph, mixed graph.
- Incidence relation and degree of the graph.
- Complete, regular graphs.

Unit 2: Paths and Circuits **(6 hrs)**

- Sub graph, connected and disconnected graphs.
- Walk and unilateral components.
- Euler graphs, Unicursal graph, Operation of graph, Circuit & Tree.
- Hamiltonian path and cycles.

Unit 3: Trees and Fundamental Circuits **(9 hrs)**

- Tree.
- Some properties of Trees.
- Distance and Centres of Trees.
- Rooted and Binary Trees.
- Cut-set, connectivity and separability.
- Fundamental Circuit and Cut-Set.

Unit 4: Planar and Dual Graphs and Vector space associated with a graph. **(9 hrs)**

- Planner graphs and their different representation.
- Dual of a planner graph.
- Euler's formula.
- Kuratowski's first and second non-planner graph.
- Circuit subspace and cut sets subspace.
- Orthogonal space.

Unit 5: Coloring, Covering, Partitioning and Matrix representation of a graph. (6 hrs)

- Vertex coloring , edge coloring.
- Chromatic number, Chromatic partition.
- Cyclic graph and decyclization of cyclic graphs.
- Adjacency matrix, Incidence matrix, Path matrix.

TEXT BOOKS: -

1. Narsingh Deo, Graph Theory with applications to engineering and computer science, Prentice-Hall of India Pvt. Ltd. New Delhi.
2. A First Look at Graph Theory - John Clark and Derek Allan Holton, Allied Publishers Limited.

REFERENCE BOOKS:-

1. R. J. Wilson, Introduction to Graph Theory, Longman.
2. Douglas B. West, Introduction to Graph Theory, Prentice-Hall of India, Second Edition, 2006, ISBN-81-203-2142-1.
3. S. Arumugam, S. Ramchandran, Invitation to Graph Theory, Scitech Publication (India) Pvt. Ltd, Chennai.
4. S. A. Choudum, A First Course in Graph Theory, Macmillan India Limited.

Semester –VI			
16UMTDC05	**DSE-CORE 2:** Complex Analysis	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Extend concepts of analysis of real variables to complex numbers.
2. Differentiate and Integrate Complex functions.
3. Evaluate contour integration.
4. Apply techniques of Complex analysis to summation of series.
5. Apply conformal mappings to problems from physical science

Unit 1: Analytic Functions **(5Hrs)**

- Functions of Complex variables
- Continuity and Differentiability of Complex Functions
- Definition of Analytic and Entire Functions
- Necessary and Sufficient condition for f(z) to be analytic
- C-R equations in Polar form
- Examples and Theorems of analytic and entire functions

Unit 2: Harmonic Functions **(5 Hrs)**

- Harmonic Functions and Conjugate Harmonic Functions
- Laplace Equation in Polar and Cartesian form
- Example based on Harmonic Functions
- Milne Thomson Theorem
- Examples on Milne Thomson Theorem

Unit 3: Contour Integral **(9Hrs)**

- Definite integral contours, line integrals
- Cauchy-Goursat theorem **(without proof)**
- Cauchy's integral formula and Higher order derivative of analytic function
- Morera's theorem, Cauchy's inequality and Liouville's theorem
- Fundamental theorem of algebra
- Maximum modulus theorem.

Unit 4: Power series and, Residues and poles **(8 Hrs)**

- Definition of complex sequence, complex series and power series
- Expansion of a complex function in Taylor's series and Laurent's series.
- Definition of a singular point, Isolated singular points,
- Zeros of complex functions, Poles and residues of complex function
- Cauchy's residue's theorem,
- Evaluation of improper real integrals by residue theorem
- Evolution of definite integral of trigonometric functions by residue theorem.

Unit 5: Mapping and Conformal mapping: **(9 Hrs)**

- Elementary functions, mapping by elementary functions,
- Linear function, Bilinear mapping **w=(az+b)/(cz+d)**,
- Discuss the mapping $w = z^2$, $w = \frac{1}{z}$, $w = e^z$
- Some more Transformations.

TEXT BOOKS: -

1. Shanti Narayan and Dr. P. K. Mittal , Theory of Functions of a Complex variable , S. Chand Publishing, 1956.
2. Dennis G. Zill and Patrick D. Shanahan, A First Course in Complex Analysis with Applications, 2nd edition, Jones and Bartlett Publishers, 2009.

REFERENCE BOOKS:-

1. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., Mc Graw – Hill International Edition, 2009.
2. Joseph Bak and Donald J. Newman, Complex Analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.

Semester – VI			
16UMTDC06	**DSE – CORE 2:** Mathematical Modelling	**3 hrs/week**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand concept of Mathematical Modelling.
2. Analyze Non-linear growth & decay models.
3. Solve the Models involving Differential Equations.
4. Critically analyze effect of immigration & emigration of population size using Mathematical Modelling.
5. Apply Mathematical Modelling for scientific and economic laws.

Unit 1: Introduction of Mathematical Modelling (7 hrs)

- Mathematical modelling through ordinary differential equation of first order, Linear growth models
- Linear decay models
- Models for growth of Science & scientists

Unit 2: Non-linear growth & decay models (7 hrs)

- Non-linear growth & decay models
- Model of Logistic law of population
- Spread of technological innovation
- Spread of infectious diseases.

Unit 3: Models involving Differential Equations (7 hrs)

- Mathematical models of geometrical problems through ordinary differential equation of first order
- Simple geometrical problems
- Orthogonal trajectories

Unit 4: Different areas of application of Mathematical Modelling (7 hrs)

- Mathematical modelling of effect of immigration & emigration of population size
- Mathematical models of rate of compound interest
- Mathematical models of radioactive decay
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Unit 5:Application of Mathematical Modelling for scientific and economic laws. (7 hrs)

- Mathematical modelling of Newton's cooling law
- Mathematical modelling of Fick's law of diffusion
- Mathematical modelling of change in price of commodity.

TEXT BOOKS: -

1. J.N. Kapoor, Mathematical Modelling, New Age International Publishers, New Delhi.
2. Kerysin, Advanced Engineering Mathematics, John Wiley, New York, 1999

REFERENCE BOOKS:

1. J.K. Sharma, OR Theory & Applications, Mac Milian India Ltd., 1998
2. G.Hadley, Linear Programming, Narosa Publishing House, New Delhi,1995
   G. Paria, Linear Programming, Transportation, Assignment, Game, Books & Allied Pvt. Ltd. Calcutta-9

Semester – VI			
16UMTCC29	**CORE PRACTICAL 12:** Optimization Practical	**4 hrs/week**	**2 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand the importance and scope of the subject Operations Research.
2. Develop and formulate problems in mathematics terms from given real life problems.
3. Solve linear programming problems with the methods including Simplex Method.
4. Solve Transportation Problems, Assignment Problems and Sequencing Problems.
5. Understand, analyze and effectively solve the problems related to the theory of games.

List of Experiments

1. Solve the given LPP using Graphical method.
2. Solve the given LPP using Simplex method.
3. Solve the given LPP using BIG -M method.
4. Solve the given LPP using TWO-PHASE method.
5. Obtain DUAL of the given Primal LPP;
6. Find the initial solution of given transportation problem using NWCM method.
7. Find the optimum solution of given transportation problem using LCM method.
8. Find the optimum solution of given transportation problem using VAM method.
9. Find the optimum solution of given transportation problem using MODI method.
10. Find the optimum solution of given assignment problem.
11. Find the optimum solution of given two-person zero sum game without saddle point.
12. Find the optimum solution of given two-person zero sum game using iterative method.
13. To find optimum solution of sequencing problem with n-jobs through two machines.
14. To find optimum solution of sequencing problem with n-jobs through three machines.

TEXT BOOKS: -

1. J. K. Sharma, Operations Research (theory and Applications), MacMillan Publishing House
2. R. K. Gupta, Operations Research, Krishna Prakashan Mandir, Meeut.

REFERENCE BOOKS:-

1. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
2. Kanti Swaroop and Manmohan, Operations Research, Sultanchand and Sons.

Semester – VI			
16UMTCC30	**CORE PRACTICAL 13:** Numerical Analysis - II Practical	**4 hrs/week**	**2 Credits**

Objectives: -

Upon completion of the course students will be able to

1. Understand the concept of interpolation.
2. Analyze and process data with equal or unequal interval and interpolate the same for given non-tabulated values.
3. Perform numerical differentiation using various formulae including Gregory-Newton's forward difference formula and Sterling's formula.
4. Perform numerical integration using various formulae including Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule.
5. Solve ordinary differential equations numerically using method including Taylor's series method, Picard's method, Euler's method, Runge's method and Runge-Kutta methods.

List of Experiments

1. Gauss forward interpolation formula.
2. Gauss backward interpolation formula.
3. Sterling's formula.
4. Bessel's formula.
5. Laplace-Everett's formula.
6. Interpolation with unequal intervals.
7. Numerical differentiation.
8. Numerical integration.
9. Taylor's formula.
10. Picard's formula.
11. Euler's method.
12. Runge's method
13. Runge-Kutta's method
14. Milne's method

TEXT BOOKS: -

1. Numerical methods by Dr. V. N. Vedamurthy & Dr. N. Ch. S. N. Iyengar, Vikas Publishing house.

REFERENCE BOOKS:-

1. Introduction to Numerical Analysis (2nd Edition) by C. E. Froberg Addision Wesley, 1979.
2. Numerical method, Problems & Solutions, by M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International Pvt. Ltd., 1996.
3. Numerical Mathematical Analysis, by J. B. Scarforough, Oxford & IBH Publication Co. Pvt. Ltd., 1966.

Semester – VI			
16UMTCC31	**CORE PRACTICAL 14:** Introduction to SAGE Practical	**4 hrs/week**	**2 Credits**

Objectives:-

1. Install and use SAGE on computer with different operating systems.
2. Understand and utilize the interface of SAGE effectively.
3. Utilize SAGE commands to solve mathematical problems of symbolic nature.
4. Apply techniques of SAGE to solve mathematical problems numerically.
5. Plot 2D and 3D graphs using the SAGE software.
6. Solve problems of mathematics including Calculus, Linear Algebra, Abstract Algebra and Group Theory.

List of Experiments

1. Introduction and practice of usage of variables, constants, data types, some inbuilt (library) constants & functions , how to enter a matrix, how to enter a vector, operators, how to get help etc.
2. To learn the usage of SAGE commands including Solve(), binomial(), maximum_on_intervals(), sum(), binomial(), prod(),...etc
3. To find limit, derivative, maxima-minima, partial derivative, indefinite and definite integral, numerical integral and Taylor series expansion of a given function
4. To draw a line passing through a given points, polygon, circle and using options in plotting of 2D graphs.
5. To draw the graph of given function in 3D including line, sphere, platonic solids and using options in plotting of 3D graphs
6. Practical based on Simplification, Factorization and expansion of symbolic functions.
7. Practical based on Partial Fractions.
8. Find the solution of problems of Linear Algebra by using SAGE Commands.
9. Find the solution of problems of Number Theory by using SAGE Commands.
10. Find the solution of various problems of Group Theory and Graph Theory by using SAGE Commands.

TEXT BOOKS: -

1. David Joyner, William Stein, Sage Tutorial.

REFERENCE BOOKS:-

1. Craig Finch, Sage Beginner's Guide, Packt publishing (Open Source Community).

Websites:-

1. Down-load SAGE for windows platform http://www.sagemath.org/download-windows.html
2. Sage Feature Tour:- http://www.sagemath.org/tour.html
3. Sage standard documentation:- http://www.sagemath.org/help.html
4. SAGE DOCUMENTATION:- http://www.sagemath.org/doc/
5. Personal Web page of William Stein :- http://modular.math.washington.edu/
6. Downloading VMware Player:- http://www.vmware.com/products/player/.
7. Latest version of VMware Player:- https://my.vmware.com/web/vmware/free#desktop_end_user_computing/vmware_player/6_0
8. VMware Player FAQs:- http://www.vmware.com/products/player/faqs.html