Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
Third Year of B.Sc.
(2024 Course under NEP 2020)

Course Code: 24ScMatU5102
Course Name: Groups and Rings
Teaching Scheme: TH: 4 Hours/Week **Credits: 4**
Examination Scheme: CIA: 40 Marks **End-Sem : 60 Marks**

Prerequisites:

- Basic Knowledge of sets, permutations, functions and types of functions

Course Objectives:

To Study

- Concept of different types of groups and their subgroups.
- Normal subgroups and factor groups.
- Permutation groups and alternating groups.
- Group and ring homomorphism and isomorphism.
- Rings, Integral domains.
- Euclidean domains, Principal ideal domains, Unique factorisation domain.

Course Outcomes:

On completion of the course, student will be able to:-

- Understand various types of groups.
- Guess subgroups of given order of finite groups.
- Represent a finite group by the permutation group.
- Homomorphism and isomorphism of groups and rings.
- Divisibility and factorization in integral domains.

Course Contents:

Unit 1	**Groups and Subgroups**	8 lectures
	• Introduction and examples • Binary Operations • Groups and Subgroups • Cyclic groups	
Unit 2	**Permutations, Cosets and Factor groups**	12 lectures
	• Groups of permutations	

	• Orbits, Cycles and Alternating Groups Cosets and Lagrange theorem • Normal subgroups • Factor groups • Direct products and finitely generated abelian groups	
Unit 3	**Group Homomorphisms**	8 lectures
	• Homomorphisms • First isomorphism theorem and its applications • Cayley's theorem	
Unit 4	**Introduction to Rings**	12 lectures
	• Definition and examples • Subrings • Integral domains and fields • Characteristic of a rings	
Unit 5	**Ideals and Ring Homomorphisms**	8 lectures
	• Ideals • Factor rings • Prime ideals and Maximal ideals • Ring homomorphisms • Fundamental theorem of homomorphism	
Unit 6	**Divisibility and factorization**	12 lectures
	• Ring of Gaussian integers • Euclidean domain • Principal ideal domain • Unique factorization theorem	
Total		60 lectures

Reference Books:

1. A first course in Abstract Algebra by John B. Fraleigh, Pearson, (7th edition) 2002.
2. Contemporary Abstract Algebra by Joseph A. Gallian, Chapman and Hall/CRC, 2020.
3. Topics in Algebra by I. N. Herstein, John Wiley & Sons (3rd edition), 1996
4. Basic Abstract Algebra by Jain and Bhattacharya, Cambridge University Press (2nd edition), 2003.

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Third Year B.Sc.
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Course Code : 24ScMatU5103
Course Name: Vector Calculus
Teaching Scheme: TH: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Basic knowledge of vectors, scalar product, vector product.
- Basic knowledge of limit, continuity and derivative of a real valued function.

Course Objectives:

- The aim of this course is to understand the vector functions, derivative and integral of vector function.
- To understand the concept of scalar and vector fields in two and three dimensions.
- To study differential operators such as gradient, divergence, and curl and their physical interpretations.
- To understand line integrals, surface integrals, and volume integrals.
- To equip students with tools to calculate flux, circulation, and work.

Course Outcomes: Student will be able to

- Compute and interpret gradient, divergence, and curl of vector fields.
- Evaluate line integrals and determine whether a vector field is conservative.
- Evaluate surface and volume integrals using appropriate techniques.
- Apply Green's, Stokes', and Gauss Divergence Theorems to simplify and solve integrals.
- Solve real-life problems involving fluid flow, electromagnetism, and gravitational fields using vector calculus concepts.

Course Contents

Unit 1	Vector Functions of one Variable	06 lectures
	• Vector valued functions • Limits and Continuity of vector function • Derivative of vector function	
Unit 2	Differential Operators	10 lectures

	• Gradient of scalar field • Directional derivative of a scalar point function • Divergence of a vector point form • Curl of a vector point function • Irrotational and solenoidal vector fields • Vector Identities	
Unit 3	Vector Integration	14 lectures
	• Line integral • Surface integrals • Volume integrals • Green's theorem in the plane • Stokes' theorem • Gauss divergence theorem	
	Total Hours	30 lectures

Text/Reference Books :

1. J. N. Sharma, A. R. Vasishtha, Vector Calculus, Krishna Prakashan Media, Thirteenth Edition: 2004.
2. Thomas' Calculus, 11th Edition, G. B. Thomas.Revised by Maurice D. Weir, Joel Hass and Frank R. Giordano. Pearson Edition 2012.Articles: 13.1, 13.3, 13.4, 16.1 to 16.8.
3. T.M. Apostol, Calculus Vol. II (2nd Edition), John Wiley, New York, (1967).
4. Basic Multivariable Calculus, J. E. Marsden, A. J. Tromba , A. Weinstein, Springer Verlag (Indian Edition).
5. Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S.Chand and Company.

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Third Year B.Sc.
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Course Code: 24ScMatU5104
Course Name: Lab Course on Operations Research
Teaching Scheme: TH: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisites: Formulation of linear programming problem and graphical method.

Course Objectives: The aim of this course is

- To study a quantitative approach for effective decision making.
- To study modeling of real life problems.
- To study how to apply the Simplex Method, graphical methods to solve linear programming problems.
- To gain proficiency in solving transportation problems using North-West Corner Method, Least Cost Method, and Vogel's Approximation Method, and to optimize this solution using the MODI method.
- To understand the structure of the Assignment Problem and learn to solve by Hungarian Method.

Course Outcomes: On completion of the course,

- Students will be able to formulate real-world problems as linear programming models.
- Students will gain the skill to apply methods such as Simplex and Big-M methods.
- Students will understand the concept of duality in LPP, the relationship between primal and dual problems, and its use in sensitivity analysis and economic interpretation.
- Students will solve transportation problems using the North-West Corner Rule, Least Cost Method, Vogel's Approximation Method, and the MODI Method.
- Students will be able to solve assignment problems using the Hungarian Method.

Course Contents:

Practical 1: Formulation of Linear Programming Problem (LPP)
Practical 2: Standard and canonical forms
Practical 3: Graphical solution of LPP
Practical 4: Basic solutions of LPP
Practical 5: Simplex method
Practical 6: Big-M method
Practical 7: Types of solutions of LPP

Practical 8: Duality
Practical 9: Initial basic feasible solutions (IBPS) of transportation problem (NWCM & LCEM)
Practical 10: IBPS of transportation problem using VAM method
Practical 11: Modified Distribution method
Practical 12: Maximization in transportation problem.
Practical 13: Hungarian method
Practical 14: Restricted Assignment problem
Practical 15: Maximization in assignment problem

Reference Books:

1. J. K. Sharma, Operations Research Theory and Applications (second edition, 2006), Macmillan India Ltd.
2. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
3. Hira and Gupta, Operation Research (Twentieth Edition, 2009), S. Chand and Company Ltd., New Delhi.
4. S. D. Sharma, Operations Research (Thirteenth edition, 2001), Kedar Nath Ram Nath and Company.

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Third Year of B.Sc.
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Course Code: 24ScMatU5201
Course Name: C Programming Language
Teaching Scheme: TH: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisites:
- Basic flowcharts and algorithms.

Course Objectives:
- To develop the ability of students to analyze the problem and develop algorithms to solve the problem.
- To develop the programming skill and logic to solve arithmetic and logical problems.
- To understand the various steps in program development through the structured programming approach.
- To learn the syntax and semantics of C programming language thereby learning the programming concepts in general.

Course Outcomes:

After successful completion of this course students will able to:
- Identify and define appropriate own logic to solve any problem using programming tools.
- Outline the solutions of the problems in the form of algorithms, flowcharts.
- Construct the problem in the form of a program using C language constructs like conditional branching, iteration and recursion.
- Examine the program with syntax error, logical error and runtime error, debug and correct the program.
- Code, test and debug the given logic in C programming language. Also, to test and execute the programs with different case values.
- To decompose a problem into functions and to develop modular reusable code.

Course Contents:

Unit 1	**Introduction to C**	10 lectures
	• Introduction to C • Structure of a C Program • C Character Set	

	• Data types and qualifiers • Operators and expressions, macros • Precedence and associativity rules • Formatted input and output	
Unit 2	**Control Structures**	7 lectures
	• Decision making structures • Branching statements: if else, nested if else, switch cases • Loop control structures: while, do while, for • Nested control structures • Break, continue, exit, statement	
Unit 3	**Arrays and Pointers**	7 lectures
	• Array definition, declaration, initialization • Multidimensional arrays • Memory representation of arrays • Arrays and pointers	
Unit 4	**Functions in C**	6 lectures
	• Introduction and need of a function • Standard library functions • User defined functions : function call, pass by value, pass by reference • Scope of variables • Recursion	
Total		30 lectures

Reference Books:

1. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI ,2nd Edition, 1988.
2. Let us C by Yashwant Kanetkar, BPB Publication, 2002.
3. C: The Complete Reference, Schildt Herbert, 4 th edition, McGraw Hill, 2000.
4. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India, 2000.
5. Programming in C, A Practical Approach, Ajay Mittal , Pearson , 2012.
6. Programming with C, B. Gottfried, 2nd edition, Schaum's outline Series, Tata McGraw Hill, 1996.
7. Programming in ANSI C, E. Balagurusamy, 6th Edition, McGraw Hill, 2012.
8. Problem Solving and Programming Concept, Maureen Sprankle, 7 th Edition, 2006.
9. How to Solve it by Computer, R.G. Dromey, Pearson Education. 1982.

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Third Year of B.Sc.
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Course Code: 24CsMatU5202
Course Name: Lab Course on 24ScMatU5201
Teaching Scheme: 4 Hours/Week **Credit : 02**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:
- Problem solving techniques
- Knowledge of basic C course

Objectives:
- Design and implement a C programs for simple problems
- Understand appropriate use of C data types and C operators.
- Understand use of appropriate control structure and Functions.

Course Outcomes: After successful completion of this course students will able to:
- Define algorithms and flowcharts for given problems in C programming.
- Illustrate the use of simple data types, operators and control structures in C programming.
- Implement various standard library functions in C programming.
- Divide the programs into separate modules by writing user defined functions.
- Evaluate the programs using appropriate debugging methods to test and validate the output.
- Design and write programs to implement the concepts of functions in C programming.

Course Contents:

Practical 1: Simple programs

Practical 2: Validity of date

Practical 3: Fibonacci sequence

Practical 4: Number palindromes

Practical 5: Patterns and Pascal's triangle

Practical 6: Prime numbers and perfect numbers

Practical 7: Average of numbers

Practical 8: Sorting an array

Practical 9: Roots of quadratic equation

Practical 10: Taylor's series

Practical 11: Name palindromes

Practical 12: Operation on matrices

Practical 13: Inverse of a matrix

Practical 14: Tower of Hanoi

Practical 15: Customer records

Reference Books:

1. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI ,2nd Edition, 1988.
2. Let us C by Yashwant Kanetkar, BPB Publication, 2002.
3. C: The Complete Reference, Schildt Herbert, 4 th edition, McGraw Hill, 2000.
4. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India, 2000.
5. Programming in C, A Practical Approach, Ajay Mittal , Pearson , 2012.
6. Programming with C, B. Gottfried, 2nd edition, Schaum's outline Series, Tata McGraw Hill, 1996.
7. Programming in ANSI C, E. Balagurusamy, 6th Edition, McGraw Hill, 2012.
8. Problem Solving and Programming Concept, Maureen Sprankle, 7 th Edition, 2006.
9. How to Solve it by Computer, R.G. Dromey, Pearson Education. 1982.

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Third Year of B.Sc.
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Course Code: 24ScMatU5203
Course Name: Metric Spaces
Teaching Scheme: TH: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites: Basic knowledge of
- Limit, continuity of a function of one variable.
- Distance formulae in R^n.
- Sets and inequalities in R.

Course Objectives: To study
- Metric in general set.
- Open and closed sets.
- Continuity in metric space.
- Completeness, compactness and connectedness.
- Metric Topology.

Course Outcome: On completion of this course, student will be able to
- Define metric on a general set.
- Check continuity in metric space and also in R.
- Use the concepts to study courses in analysis.
- Understand the concept of topological spaces.

Course Contents:

Unit 1	**Introductory concepts**	10 lectures
	• Definition and examples of metric spaces. • Open and closed spheres. • Limit points, interior points, isolated points. • Open and closed sets, closure of a set. • Boundary points, distance between sets and diameter of a set. • Continuous functions on metric spaces.	
Unit 2	**Completeness**	5 lectures

	• Convergent sequences. • Cauchy sequences. • Complete spaces. • Dense sets	
Unit 3	**Compactness and Connectedness**	12 lectures
	• Compact spaces. • Continuous functions and compact spaces. • Separated sets. • Disconnected and connected sets.	
Unit 4	**Introduction to Topology**	03 lectures
	• Definition with examples • Metric topology	
	Total No. of Lectures	30 lectures

Reference Books:

1. Metric Spaces by Pawan K. Jain and Khalil Ahmad, Narosa Publishing House, (Second Edition), 2004.
2. Topology of metric spaces by S. Kumaresan, Narosa Publishing House, 2005.
3. Methods of Real Analysis by R. R. Goldberg, Oxford and I.B.H. publications, 1970.
4. A first course in Mathematical Analysis by D. Somasundaram and B. Choudhary, Narosa Publishing House, 1996.
5. Real mathematical analysis by C. C. Pugh, Springer publication (2^{nd} edition), 2010.

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Third Year of B.Sc.
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Course Code: 24ScMatU5204
Course Name: Lab Course on 24ScMatU5203
Teaching Scheme: 4 Hours/ Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites: Basic knowledge of

- Limit, continuity of a function of one variable.
- Distance formulae in R^n.
- Sets and inequalities in R.

Course Objectives: To study

- Metric on general set.
- Open and closed sets.
- Continuity in metric space.
- Completeness, compactness and connectedness.
- Metric Topology

Course Outcome: On completion of this course, student will be able to

- Define metric on a general set.
- Check continuity in metric space and also in R.
- Use the concepts to study courses in analysis.
- Understand the concept of topological spaces

Course Contents:
Practical 1: Metric spaces
Practical 2: Open and closed spheres
Practical 3: Limit points and Interior points
Practical 4: Isolated points and Boundary points
Practical 5: Closure of a set
Practical 6: Continuous functions on metric spaces
Practical 7: Sequential continuity in metric spaces
Practical 8: Convergent and Cauchy sequences
Practical 9: Completeness
Practical 10: Compactness
Practical 11: Connectedness
Practical 12:Continuous functions on compact sets
Practical 13: Continuous functions on connected sets

Practical 14: Topology
Practical 15: Metric topology

Reference Books:

1. Metric Spaces by Pawan K. Jain and Khalil Ahmad, Narosa Publishing House, (Second Edition), 2004.
2. Topology of metric spaces by S. Kumaresan, Narosa Publishing House, 2005.
3. Methods of Real Analysis by R. R. Goldberg, Oxford and I.B.H. publications, 1970.
4. A first course in Mathematical Analysis by D. Somasundaram and B. Choudhary, Narosa Publishing House, 1996.
5. Real mathematical Analysis by C.C. Pugh, Springer publication (2^{nd} edition), 2010.

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Third Year of B.Sc.
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Course Code: 24ScMatU5501
Course Name: Lab course on Computer Oriented Numerical Methods
Teaching Scheme: PR: 4 Hours/Week **Credit : 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses: Algebra, Calculus, Differential Equations, Polynomials, C Programming Language

Course Objective: To Study

- Errors and their computations.
- Methods for solution of algebraic and transcendental equations.
- Polynomial interpolation.
- Numerical differentiation and integration.
- Numerical methods to solve ordinary differential equations.

Course Outcomes: On completion of the course, student will be able to

- Find a real root of algebraic and transcendental equations.
- Approximate an unknown continuous function by a polynomial, with desired accuracy.
- Find the value of a definite integral of explicitly unknown function, given a set of data points.
- Solve first order ordinary differential equations.

Course Contents:

Practical 1 : False position method
Practical 2 : Newton's Raphson method
Practical 3 : Difference table
Practical 4 : Newton's forward difference interpolation method
Practical 5 : Newton's backward difference interpolation method
Practical 6 : Gauss forward difference interpolation method
Practical 7 : Gauss backward difference interpolation method
Practical 8 : Stirling's interpolation method
Practical 9 : Newton's divided difference interpolation method
Practical 10 : Lagrange's interpolation method
Practical 11 : Trapezoidal rule
Practical 12 : Simpson's 1/3 rule
Practical 13 : Simpson's 3/8 rule
Practical 14 : Euler's method
Practical 15 : Runge-Kutta method

Reference Books :

1) Computer Oriented Numerical Methods, by V. Rajaraman, PHI, Third Edition, 2009.
2) Numerical Methods With programs in C, by T Veerarajan and T Ramachandran, Tata McGraw-Hill Publishers, First Edition, 2008.
3) A textbook of Computer Based Numerical and Statistical Techniques, by A. K. Jaiswal and Anju Khandelwal, New Age International Publishers, 2009.
4) Applied Numerical Methods in C, by Shoichiro Nakamura, Prentice Hall, 1993.

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Third Year of B.Sc.
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Course Code: 24ScMatU5302
Course Name: Lab Course on Ordinary Differential Equations
Teaching Scheme: TH: 4 Hours/Week **Credits: 02**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisites:
- Derivative, Integration.

Course Objectives:

To Study
- Differential equations, order and degree of differential equation.
- Homogeneous linear differential equation.
- Non-homogeneous differential equation.

Course Outcomes:

On completion of the course, student will be able to:-
- Find order and degree of differential equations.
- Find the Wronskian of solutions of differential equations.
- Find the solution of homogeneous, Pfaffian, exact differential equations.
- Solve Bernoulli's equation.
- Find solution of homogeneous differential equations with constant coefficients.
- Find solution of non-homogeneous differential equations.

Course Contents:

Practical 1: Classification
Practical 2: Formation of differential equations
Practical 3: Linear dependence and independence of set of functions
Practical 4: Wronskian
Practical 5: Variable separable method
Practical 6: Homogeneous differential equations
Practical 7: Exact differential equations
Practical 8: Non-exact differential equations
Practical 9: Linear differential equations
Practical 10: Bernoulli's equation
Practical 11: Linear differential equation with constant coefficients
Practical 12: Particular integrals for non-homogeneous differential equations
Practical 13: Method of undetermined coefficients

Practical 14: Method of variation of parameters
Practical 15 : Method of reduction of order

Reference Books:

1. Ordinary and Partial Differential Equation by M. D. Raisinghania, S. Chand and company LTD, 2009.
2. Elementary Differential Equations by Rainville and Bedient, Macmillan Publications, 1952.
3. Differential Equations: Theory, Technique and Practice by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill, 2007.
4. Integral Calculus by Shanti Narayan, S. Chand and Company, 1987.

Level:- 5.5 (Third Year) Sem:VI

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Third Year of B.Sc.
(2024 Course under NEP 2020)

Course Code: 24ScMatU6101
Course Name: Complex Analysis
Teaching Scheme: TH: 4 Hours/Week **Credits: 4**
Examination Scheme: CIA: 40 Marks **End-Sem : 60 Marks**

Prerequisites: Basic Knowledge of

- Complex numbers.
- Algebra and Calculus.

Course Objectives: The aim of this course is to study.

- Continuity, Differentiability of functions of complex variables.
- Exponential, logarithmic, trigonometric, hyperbolic functions.
- Analytic functions, harmonic functions and relation between them.
- Contour integrals.
- Series and power series.
- Residues and poles.

Course Outcomes: On completion of this course, student will be able to: -

- Check whether the given function is analytic.
- Prove identities involving elementary functions.
- Evaluate contour integrals and improper integrals.
- Find Laurent series expansion of complex functions.
- Classify singular points of complex functions.
- Apply Cauchy residue theorem to solve line integrals.

Course Contents:

Unit 1	Analytic functions	12 lectures
	• Functions of complex variable, limits and continuity • Derivatives, differentiation formulae • Cauchy Riemann equations, sufficient condition for differentiability, polar coordinates • Analytic functions and harmonic functions.	
Unit 2	Elementary functions	10 lectures

	• Identities of trigonometric and hyperbolic functions. • Exponential function • Logarithmic function • Branches of logarithmic function.	
Unit 3	Integrals	14 lectures
	• Path integral and contour integral • Cauchy Goursat theorem and simply connected domains • Cauchy integral formula and its generalisation • Liouville's theorem • Fundamental theorem of algebra and its applications	
Unit 4	Series	08 lectures
	• Taylor's series and Maclaurin series. • Laurent's series.	
Unit 5	Residues and Poles	16 lectures
	• Types of singularities • Zeros and poles • Residue at simple and multiple order pole • Cauchy residue theorem • Applications in evaluation of improper integrals	
	Total No. of Lectures	60

Reference Books:

1. Complex Analysis and Applications by J. W. Brown and R. V. Churchill, International Student 8th edition, 2009.
2. Complex Variables with Applications by S. Ponnusamy and H. Silverman, Birkhauser, 2006.
3. Functions of One Complex Variable by J. B. Conway, Narosa publication, Second edition 1978.
4. Complex Analysis by Murray Spiegel, McGraw Hill, Second edition, 2009.

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Third Year of B.Sc.
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Course Code: 24ScMatU6102
Course Name: Differential Equations
Teaching Scheme: TH: 4 Hours/Week **Credits: 4**
Examination Scheme: CIA: 40 Marks **End-Sem : 60 Marks**

Prerequisites:

- Derivative, Integration, Partial derivatives, Continuity, Analytical geometry

Course Objectives:

To Study

- Second order linear differential equations
- Power series solution of first and second order linear differential equations
- System of first order and first degree differential equations
- First order partial differential equations

Course Outcomes:

On completion of the course, student will be able to:-

- Find the general solution of linear differential equations with constant coefficients.
- Find the solution of non - homogeneous differential equations..
- Find the solution of a system of first order differential equations.
- Solve simultaneous differential equations of the first order and first degree in three variables.
- Solve first order linear and non-linear partial differential equations.
- Find an integral surface passing through a given curve.

Course Contents:

Unit 1	**Ordinary Differential Equations**	10 lectures
	• Exactness of first order differential equations. • Non-exact differential equations • Linear differential equations • Homogeneous differential equations with constant coefficients, auxiliary equations • Distinct roots, repeated roots and complex roots of the auxiliary equations	
Unit 2	**Non-Homogeneous Differential Equations**	15 lectures

	• The operator $\frac{1}{f(D)}$ and short cut methods for $e^{ax}, sin(ax), cos(ax), e^{ax}V$ • Method of variation of parameters • Method of reduction of order • Method to obtain a second solution, given a solution.	
Unit 3	**Simultaneous differential equations of first order equations in three variables**	05 lectures
	• Method of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ • Orthogonal trajectories of a system of curves on a surface	
Unit 4	**Linear Partial differential equations**	15 lectures
	• Formation of partial differential equations • Classification of first order partial differential equations • Method of solving linear equations pP + qQ = R. • Pfaffian differential equations • Integrability of Pfaffian differential equations	
Unit 5	**Nonlinear partial differential equations**	15 lectures
	• Compatible systems • Charpit's method • Special cases of first order partial differential equations using Charpit's method • Integral surfaces through given curve: The Cauchy problem	
	Total Lectures	**60 lectures**

Reference Books:

1. An elementary course in Partial Differential Equations by T. Amarnath, Narosa Publishing House (2nd edition), 2008.]
2. Ordinary and Partial Differential Equation by M. D. Raisinghania, S. Chand and company LTD, 2009.
3. Differential Equations: Theory, Technique and Practice by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill, 2007.
4. Partial Differential Equations by W. E. Williams, Clarendon Press, Oxford, 1980.

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Third Year of B.Sc.
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Course Code: 24ScMatU6103
Course Name: Number Theory
Teaching Scheme: TH: 2 Hours/Week **Credits: 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisites:

- Basic knowledge of number systems, divisibility in integers and prime numbers.

Course Objectives:

To Study

- The properties of prime numbers.
- The application of congruences.
- The applications of arithmetic functions.

Course Outcomes:

On completion of the course, student will be able to understand

- The Euclidean algorithm and fundamental theorem of arithmetic.
- The use of Euler's and Fermat's theorem.
- The use of the Mobius inversion formula and the law of quadratic reciprocity.

Course Contents:

Unit 1	Divisibility	8 lectures
	• Division algorithm. • Greatest common divisor and its properties. • Euclidean algorithm. • Fundamental theorem of arithmetic. • Primes	
Unit 2	**Theory of Congruences**	6 lectures
	• Properties of congruences. • Linear congruences. • Fermat's theorem, Wilson's theorem. • Chinese remainder theorem.	
Unit 3	**Arithmetic functions**	8 lectures

	• τ function, σ function, Greatest integer function, Euler's phi function • Mobius inversion formula • Properties of Euler's phi function	
Unit 4	**Quadratic Reciprocity**	8 lectures
	• Legendre symbol and examples. • Properties of Legendre symbols. • Quadratic residues and its properties. • Law of quadratic reciprocity	
Total Lectures		**30 lectures**

Reference Books:

1. Elementary Number Theory by David M. Burton, McGraw Hill, (7 th edition), 2010.
2. An Introduction to Theory of Numbers by I. Niven, H. Zuckerman and H.L. Montgomery, John Wiley and Sons, (5 th edition), 2008.
3. Elements of Number Theory by John Stillwell, Springer, 2003.

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Third Year of B.Sc.
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Course Code: 24ScMatU6104
Course Name: Lab Course on Graph Theory
Teaching Scheme: PR: 4 Hours/Week **Credit : 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses: Set Theory, Permutations, Combinations, Algebra of equations, Linear Algebra

Course Objective: To Study
- Graphs, types of graphs.
- Operations on graphs viz. Union, Intersection, Ring Sum and Product.
- Connected graphs and its properties.
- Eulerian and Hamiltonian graphs.
- Trees and their properties.
- Directed Graphs.

Course Outcomes: On completion of the course, student will be able to
- Convert real life problems into graph theoretical models.
- Check whether two graphs are isomorphic or not.
- Apply basic operations on graphs and connected graphs.
- Apply tree traversal algorithm to find value of prefix, infix and postfix expressions
- Determine minimum and maximum height of a binary tree and to draw such trees.
- Find the shortest spanning tree for a given graph.

Course Contents:

Practical 1 : Types of graphs and Handshaking lemma
Practical 2 : Energy of a graph
Practical 3 : Isomorphism of graphs
Practical 4 : Operations of graphs
Practical 5 : Eccentricity, center and radius of a graph
Practical 6 : Connectivity of a graph
Practical 7 : Shortest path problem
Practical 8 : Eulerian graphs
Practical 9 : Hamiltonian graphs
Practical 10 : Trees
Practical 11 : Fundamental circuits and cutset
Practical 12 : Tree traversal algorithms
Practical 13 : Binary tree
Practical 14 : Spanning tree

Practical 15 : Directed graphs

Reference Books :

1) A First Look at Graph Theory by John Clark and Derek Holton, Allied Publishers (1st Indian edition), 1995.
2) Graph Theory with Applications to Computer Science and Engineering by Narsingh Deo, Prentice Hall of India (3rd Indian edition), 1986.
3) Introduction to graph theory by Douglas B. West, Second edition, Pearson publication, 2015.

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
Third Year of B.Sc.
(2024 Course under NEP 2020)

Course Code: 24ScMatU6201
Course Name: Data Structure
Teaching Scheme: TH: 2 Hours/Week **Credits: 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisites: Course of C Programming language.

Course Objectives: Study of various data structures at logical, implementation and application level.

Course Outcomes:

- Understand data structures and their effective and efficient use in solving complex problems.
- Students will be able to improve their problem solving ability by using data structures.

Course Contents:

Unit 1	**Introduction to data structures**	**6 lectures**
	• Concept data structure • Abstract data type • Data Structures in C : Arrays , Pointer, Structure, Union	
Unit 2	**The Stack**	**6 lectures**
	• Definition and operations. • Implementation using array. • Infix expression and evaluation. • Postfix expression and evaluation. • Recursion.	
Unit 3	**The Queue**	**6 lectures**
	• Definition and operations • Implementation using array Linear queue and Circular queue. • Priority queue.	
Unit 4	**The Linked List**	**6 lectures**
	• Concept of pointers and dynamic memory allocation • Definition and operations	

	• Singly linear and circular linked lists • Doubly linear and circular linked lists • Implementation of stack and queue using linked lists	
Unit 5	**Hashing**	**6 lectures**
	• concept and terminologies • Hashing with and without chaining • Efficiency considerations	
	Total	30 lectures

Reference Books:

1. Data Structures Using C and C++ By Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tanenbaum 1995
2. Data Structures A Pseudocode Approach with C By Richard F. Gilberg and Behrouz A. Forouzan January 2007

Progressive Education Society's

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Third Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScMatU6202
Course Name: Lab Course on 24ScMatU6201
Teaching Scheme: PR: 4 Hours/Week **Credits: 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisites: Students must be aware of C Programming.

Course Objectives: Study of various data structures at logical, implementation and application level.

Course Outcomes:

- Understand Data Structures and their effective and efficient use in solving complex problems.

· Students will able to improve their problem solving ability by using data structures

Course Contents:

Practical 1: Bubble Sort
Practical 2: Insertion Sort
Practical 3: Quick Sort
Practical 4: Merge Sort
Practical 5: Linear Sort
Practical 6: Binary search
Practical 7: convert infix expression into postfix form and evaluation of postfix
Practical 8: linked list
Practical 9: Towers of Hanoi using linked list.
Practical 10: Traversing using binary search.
Practical 11: Binary search tree to –counting nodes.
Practical 12:Check whether two trees are mirrors using binary search tree
Practical 13: Hashing .
Practical 14: Finding degree of nodes
Practical 15 : Convert matrix to list.

Reference Books:

1. Data Structures Using C and C++ By Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tanenbaum
2. Data Structures A Pseudocode Approach with C By Richard F. Gilberg and Behrouz A. Forouzan

Progressive Education Society's
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Third Year of B.Sc.
(2024 Course under NEP 2020)

Course Code: 24ScMatU6203
Course Name: Laplace Transforms and Fourier Series
Teaching Scheme: TH: 2 Hours/Week **Credits: 2**
Examination Scheme: CIA: 20 Marks **End-Sem : 30 Marks**

Prerequisites: Basic knowledge of
- Functions and linear transformations.
- Calculus.

Course Objectives: To study
- Laplace transformation of functions and convolution theorem.
- Simple techniques of evaluation of improper integrals.
- Solution of differential equations using Laplace transform
- Fourier series of piecewise continuous functions.

Course Outcomes:

On completion of the course, student will be able to -
- Evaluate improper integrals
- Solve differential equations
- Obtain Fourier series expansion of piecewise continuous functions.

Course Contents:

Unit 1	**The Laplace Transform**	10 lectures
	● Definition, Laplace transform of functions ● Properties of Laplace transform ● Laplace transforms of derivatives and integrals	
Unit 2	**The Inverse Laplace Transform**	10 lectures
	● Definition, Inverse Laplace transform ● Properties of inverse Laplace transform ● Inverse Laplace transforms of derivatives and integrals ● Convolution theorem, evaluation of integrals	
Unit 3	**Fourier Series**	10 lectures
	● Definition of Fourier series. ● Fourier series of even and odd functions ● Fourier series of periodic functions	
	Total No. of Lectures	30 lectures

Reference Books:

1. Schaum's Outline Series ,Theory and Problems of Laplace transforms by Murray R. Spiegel 1986.
2. Differential equations by G. F. Simmons and S. G. Krantz, Tata McGraw Hill (sixth edition), 2009.
3. The Laplace Transform-Theory and Applications by Joel L. Schiff , Springer Verlag New York, 1999.

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Third Year of B.Sc.
(2024 Course under NEP 2020)

Course Code: 24ScMatU6204
Course Name: Lab Course on 24ScMatU6203
Teaching Scheme: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites: Basic knowledge of
- Functions and linear transformations.
- Calculus.

Course Objectives: To study
- Laplace transformation of functions and convolution theorem.
- Simple techniques of evaluation of improper integrals.
- Solution of differential equations using Laplace transform
- Fourier series of piecewise continuous functions.

Course Outcomes: On completion of the course, student will be able to
- Evaluate improper integrals
- Solve differential equations
- Obtain fourier series expansion of piecewise continuous functions.

Course Contents:
Practical 1: Laplace of elementary functions
Practical 2: Gamma function
Practical 3: Laplace of piecewise continuous functions
Practical 4: Functions of exponential order
Practical 5: Shift properties of Laplace
Practical 6: Laplace of derivatives and integrals
Practical 7: Laplace with t-operations
Practical 8: Unit step and Delta function
Practical 9: Integral evaluation using Laplace
Practical 10: Inverse Laplace using Properties
Practical 11: Inverse Laplace using s-operations
Practical 12: Convolution Theorem
Practical 13: Fourier series of piecewise continuous functions
Practical 14: Even–Odd Fourier Series
Practical 15: Applications of Laplace and Fourier series

Reference Books:

1. Schaum's Outline Series, Theory and Problems of Laplace transforms by Murray R. Spiegel 1986
2. Differential equations by G. F. Simmons and S. G. Krantz, Tata McGraw Hill (sixth edition), 2009.
3. The Laplace Transform-Theory and Applications by Joel L. Schiff , Springer Verlag New York, 1999.

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Third Year of B.Sc.
(2024 Course under NEP 2020)

Course Code: 24ScMatU6501
Course Name: Lab Course on Python
Teaching Scheme: 4 Hours/ Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites:

- Basic computer skills
- Front End Vs Back End
- Probability and Statistics

Course objectives: The students will learn

- To introduce programming concepts using python
- To develop Programming logic using python
- To develop basic concepts and terminology of python programming
- To test and execute python programs·

Course Outcomes: On completion of the course, student will be able to–

- Develop logic for problem solving
- Determine the methods to create and develop **Python programs** by utilizing the data
- Structures like lists, dictionaries, tuples and sets.
- To be familiar with the basic constructs of programming such as data, operations, conditions, loops, functions etc.
- To write python programs and develop a small application project.

Course Contents:

Practical 1: Introduction to Python
Practical 2: Sequence Control
Practical 3: Conditional Statements
Practical 4: Looping
Practical 5: Strings
Practical 6: Python Lists
Practical 7: Arrays
Practical 8: Functions
Practical 9: Sets
Practical 10: Tuples
Practical 11: Modules
Practical 12: Packages

Practical 13: Working with files
Practical 14: Regular Expression
Practical 15: Exception Handling

Reference Books:

1. An Introduction to Computer Science using Python 3 by Jason Montojo, Jennifer Campbell, Paul Gries, The pragmatic bookshelf-2013
2. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python “, Green Tea Press, 2002
3. Introduction to Problem Solving with Python by E balguruswamy,TMH publication- 2016
https://docs.python.org/3/tutorial/index.html
https://www.rgmcet.edu.in/assets/img/departments/CSE/materials/R19/2-1/Python%20Lab.pdf