Syllabus
[UG9101- Three/Four Year Bachelor of Arts] - [UG9101-MAT-63P-202] - [Introduction to Scilab: A Mathematical Tool]
III-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	UG9101-MAT-63P-202 Introduction to Scilab: A Mathematical Tool	2 Hrs-CA 3 Hrs-EoSE	10 Marks-CA 40 Marks-EoSE	04 Marks-CA 16 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Practical	UG9101-MAT-63P-202 Introduction to Scilab: A Mathematical Tool	3 Hrs	50 Marks	20 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
III	UG9101-MAT-63P-202	Introduction to Scilab: A Mathematical Tool				6	2
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	0	2	2	Yes	Practical, Sixty Hours of Practical	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to equip students with skills to create, analyze, and understand graphs. To teach the use of computational and programming functions within Scilab. To understand and apply methods for solving linear equations and other mathematical problems.					

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Detailed Syllabus

[UG9101-MAT-63P-202] - [Introduction to Scilab: A Mathematical Tool]

Group-A

1. Plotting the graphs of the following functions ax, $\sqrt{(ax+b)}$, $|ax+b|$, $c \pm |ax+b|$, $x^{\pm n}$, e^{ax+b}, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|\sin(ax+b)|$, $|\cos(ax+b)|$. explaining the effects of change in the real constant a, b and c on graphs. Plotting graphs of hyperbolic functions and inverse trigonometric functions, plotting and analyzing the graphs of polynomials and their derivatives.
2. Complex numbers: Operations like addition, subtraction, multiplication, division, Modulus and inbuilt functions conj, imag, imult, isreal, real.

(20 Hours)

Group-B

1. Matrix operations: addition, multiplication, inverse, transpose, determinant, rank and inbuilt functions eye, ones, zeros. Solving the system of linear equations by using Matrix Division (\ Operator), using 'linsolve' function, using 'inv' function, using 'mldivide' function.
2. Finding Roots of equations by using 'fsolve' function, using 'roots' function, using 'mnewton' function.

(20 Hours)

Group-C

1. Solving linear programming problems by using inbuilt functions of Scilab.
2. Solving Ordinary Differential Equations (ODEs) by using the 'ode' function.

(20 Hours)

Suggested Books and References –

1. Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists, APress; 1st ed. Edition.
2. Claude Gomez, Engineering and Scientific Computing with Scilab, Birkhauser Boston Inc; 1999th edition.
3. Tejas Sheth, Scilab: A Practical Introduction to Programming and Problem Solving, Createspace Independent Pub.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand graphical and numerical techniques and be able to apply them using Scilab.
2. Students should gain practical expertise in solving problems involving graphs, matrices, and equations.
3. Students should be prepared to utilise various mathematical techniques to solve different mathematical problems.

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Syllabus
[UG9101- Three/Four Year Bachelor of Arts] - [UG9101-MAT-64T-203] - [Real Analysis-II & Numerical Analysis]
IV-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG9101-MAT-64T-203 Real Analysis-II & Numerical Analysis	1 Hrs-CA 3 Hrs-EoSE	20 Marks-CA 80 Marks-EoSE	08 Marks-CA 32 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG9101-MAT-64T-203 Real Analysis-II & Numerical Analysis	3 Hrs	100 Marks	40 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
IV	UG9101-MAT-64T-203	Real Analysis-II & Numerical Analysis				6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	4	0	4	Yes	Lecture, Sixty Lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		UG0803-MAT-63T-201 Real Analysis-I & Differential Equations-I					
Objectives of the Course:		The primary objective of this course is to enable students to understand fundamental concepts of differentiable functions, apply Darboux's, Rolle's theorems, Riemann integration, mean value theorems, and to learn numerical techniques viz. Interpolation, Numerical integration, roots of equation, solution of initial value problem.					

Detailed Syllabus

[UG9101-MAT-64T-203] - [Real Analysis-II & Numerical Analysis]

Unit - I

Properties of derivable functions, Darboux's and Rolle's theorem. Notion of limit, continuity and differentiability for functions of two variables. Directional derivative, total derivative, expression of total derivative in terms of partial derivatives.

(15 Lectures)

Unit - II

Riemann integration – Lower and Upper Riemann integrals, Riemann integrability, Mean value theorems of integral calculus, Fundamental theorem of integral calculus. Functions of bounded variations.

(15 Lectures)

Unit -III

Differences. Relation between differences and derivatives. Differences of a polynomial. Newton's formula for forward and backward interpolation. Divided differences. Newton's divided difference, Lagrange's interpolation formula. Numerical Differentiation. Derivatives from interpolation formulae.

(15 Lectures)

Unit-IV

Numerical integration, Derivations of general quadrature formulas, Trapezoidal rule. Simpson's one-third, Simpson's three-eighth and Gauss's quadrature formulae. Numerical solution of Algebraic and Transcendental equations: Bisection method, secant method, Regula-Falsi method, Iteration method, Newton- Raphson Method. Numerical solutions of ordinary differential equations of first order with initial conditions using Euler and modified Euler's method.

(15 Lectures)

Suggested Books and References –

1. Royden H, Fitzpatrick PM. Real analysis. China Machine Press; 2010.
2. Rudin W. Principles of mathematical analysis. New York: McGraw-hill; 1964.
3. Bartle RG, Sherbert DR. Introduction to real analysis. New York: Wiley; 2000.
4. Mapa SK. Introduction to Real Analysis. Sarat Book Distributors; 2014.
5. Malik SC, Arora S. Mathematical analysis. New Age International; 1992.
6. Burden RL, Faires JD. Numerical analysis, brooks;1997.
7. Iyengar SR, Jain RK. Numerical Methods. New Age International; 2009.
8. Sastry SS. Introductory methods of numerical analysis. PHI Learning Pvt. Ltd.; 2012.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Analyse multivariable functions using differentiability and partial derivatives.
2. Solve problems using Riemann integrability and integral calculus theorems.
3. Use interpolation formulas for data approximation and numerical differentiation.
4. Apply numerical methods to solve equations and differential equations.

Syllabus
[UG9101- Three/Four Year Bachelor of Arts] - [UG9101-MAT-64P-204] -
[Introduction to C Programming: As Mathematical Tool]
IV-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	UG9101-MAT-64P-204 Introduction to C Programming: As Mathematical Tool	2 Hrs-CA 3 Hrs-EoSE	10 Marks-CA 40 Marks-EoSE	04 Marks-CA 16 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Practical	UG9101-MAT-64P-204 Introduction to C Programming: As Mathematical Tool	3 Hrs	50 Marks	20 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
IV	UG9101-MAT-64P-204	Introduction to C Programming: As Mathematical Tool				6	2
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	0	2	2	Yes	Practical, Sixty Hours of Practical	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to enable students learn the basic knowledge of developing algorithms for various Mathematical problems and preparing codes for these algorithms in C language.					

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Detailed Syllabus

[UG9101-MAT-64P-204] - [Introduction to C Programming: As Mathematical Tool]

Programming languages and problem solving on computers, Algorithm, Flow chart, Programming in C-Constants, Variables, Arithmetic and logical expressions, Input-Output, Conditional statements, Implementing loops in Programs, Defining and manipulating arrays and functions.

Group-A

1. Printing n terms of Fibonacci sequence and finding factorial n, summation n, summation of square of n etc.
2. Defining a function and finding sum of n terms of a series/sequence whose general term is given.
3. Finding gcd and lcm of two numbers by Euclid's algorithm.
4. Checking prime/composite numbers and finding the number of primes less than n, where n is a positive integer.
5. Finding mean, standard deviation and Permutation, Combination.

(20 Hours)

Group-B

6. Numerical integration using Trapezoidal rule.
7. Numerical integration using Simpson's ⅓ rule.
8. Numerical integration using Simpson's 3/8 rule.
9. Numerical integration using Waddle rules.
10. Preparing forward and backward difference tables.

(20 Hours)

Group-C

11. Solution of algebraic and transcendental equations by Bisection method.
12. Solution of algebraic and transcendental equations by Regula-falsi method.
13. Solution of algebraic and transcendental equations by Newton-Raphson method.
14. Solution of Initial value problems by Euler's method.
15. Solution of Initial value problems by Runga-Kutta fourth order method.

(20 Hours)

Suggested Books and References –

1. B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
2. E. Balagurnsamy : Programming in ANSI C, Tata McGraw Hill, 2004.
3. Y. Kanetkar : Let Us C ; BPB Publication, 1999.
4. C. Xavier : C-Language and Numerical Methods, New Age International, 2007.
5. V. Rajaraman : Computer Oriented Numerical Methods, Prentice Hall of India, 1980.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand the logic for a given problem.
2. Write the algorithm of a given problem.
3. Draw a flow chart of a given problem.
4. Recognize and understand the syntax and construction of C programming code.

Syllabus
[UG9101- Three/Four Year Bachelor of Arts] - [UG9101-MAT-75T-301] - [Abstract Algebra & Three Dimensional Geometry]
V-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG9101-MAT-75T-301 Abstract Algebra & Three Dimensional Geometry	1 Hrs-CA 3 Hrs-EoSE	30 Marks-CA 120 Marks-EoSE	12 Marks-CA 48 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG9101-MAT-75T-301 Abstract Algebra & Three Dimensional Geometry	3 Hrs	150 Marks	60 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
V	UG9101-MAT-75T-301	Abstract Algebra & Three Dimensional Geometry				7	6
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	6	0	6	Yes	Lecture, Ninety lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					

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Objectives of the Course:	The objective of the course on Group Theory, Ring Theory, and three dimensional geometry, as outlined in the syllabus, is to provide students with a thorough understanding of fundamental algebraic structures, their applications and basic three dimensional geometrical shapes.

Detailed Syllabus

[UG9101-MAT-75T-301] - [Abstract Algebra & Three Dimensional Geometry]

Unit - I

Binary operations, Algebraic structure, Groups, Order of group, finite and infinite order groups and their order specific theorems, Subgroups and their properties, Permutation group, Cyclic group. Cosets, Lagrange's theorem.

(22 Lectures)

Unit - II

Morphism of groups, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorems of Homomorphism.

(23 Lectures)

Unit -III

Definition and simple properties of Rings and Subrings. Morphism of rings. Integral domain and field. Characteristics of a Ring and Field.

(22 Lectures)

Unit-IV

Sphere: Equation of Sphere, Plane section of sphere, intersection of a sphere by a line, tangent line and tangent plane of a sphere, angle of intersection of two spheres. Cone: Equation of cone, tangent plane of a cone, right circular cone, enveloping cone. Cylinder: Equation of cylinder, enveloping cylinder, right circular cylinder.

(23 Lectures)

Suggested Books and References –

1. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.
2. I.N.Herstein, Topics in Algebra, Wiley-Eastern Ltd., New Delhi.
3. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010).
4. N.S.Gopalkrishnan, University Algebra, New Age International, 1986.
5. G.C.Sharma, Modern Algebra, Shivlal Agrawal & Co., Agra,1998.
6. S.L. Loney, The Elements of Coordinate Geometry, Macmillan and co. London, 1895.
7. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Develop a solid theoretical foundation in algebraic structures including groups, rings, integral domains and fields.
2. Apply theoretical concepts to solve problems involving group theory, ring theory.
3. Analyze and differentiate algebraic structures and their interrelations.
4. Understand the applications of algebraic structures in various mathematical and scientific disciplines.

Syllabus
[UG9101- Three/Four Year Bachelor of Arts] - [UG9101-MAT-76T-302] - [Complex Analysis & Mechanics]
VI-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG9101-MAT-76T-302 Complex Analysis & Mechanics	1 Hrs-CA 3 Hrs-EoSE	30 Marks-CA 120 Marks-EoSE	12 Marks-CA 48 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG9101-MAT-76T-302 Complex Analysis & Mechanics	3 Hrs	150 Marks	60 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
VI	UG9101-MAT-76T-302	Complex Analysis & Mechanics				7	6
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	6	0	6	Yes	Lecture, Ninety lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to enable students to understand and apply complex analysis, principles of equilibrium and work, and solve mechanical motion problems.					

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Detailed Syllabus

[UG9101-MAT-76T-302] - [Complex Analysis & Mechanics]

Unit - I

Complex valued function: Limits, Continuity and Differentiability. Analytic functions, Cauchy-Riemann equations. Harmonic functions, Construction of an analytic function. Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function.

(22 Lectures)

Unit - II

Taylor's theorem. Laurent's theorem. Maximum modulus theorem. Singularities of an analytic function, Branch point, Meromorphic and Entire functions, Residue at a singularity, Cauchy's residue theorem.

(23 Lectures)

Unit -III

Velocity and acceleration – along radial and transverse directions, along tangential and normal directions, Motion in resisting medium – Resistance varies as velocity and square of velocity, Motion on a smooth curve in a vertical plane.

(22 Lectures)

Unit-IV

Equilibrium of coplanar forces, moments, Friction, Virtual Work and catenary.

(23 Lectures)

Suggested Books and References –

1. Brown JW, Churchill RV. Complex variables and applications. McGraw-Hill,; 2009.
2. Kasana HS. Complex variables: theory and applications. PHI Learning Pvt. Ltd.; 2005.
3. Ponnusamy S, Silverman H. Complex variables with applications. Springer Science & Business Media; 2007.
4. A.S.Ramsey, Statics, CBS Publishing & Distributors, New Delhi.
5. M. Ray, A Text Book of Dynamics, S. Chand & Co., 2003.
6. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
7. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students would have achieved the following:

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1. Grasped the concepts of Taylor's and Laurent's theorems as they apply to complex functions.
2. Conducted analysis on the singularities of analytic functions, including branch points, meromorphic functions, entire functions, and residues at singularities using the Cauchy residue theorem.
3. Understand and calculate velocity and acceleration in various directions and analyze motion in resisting media.
4. Analyze the equilibrium of coplanar forces, calculate moments, and understand the effects of friction.
5. Apply the principles of virtual work to mechanical systems and analyze motion on smooth curves in vertical planes.
6. Mathematical treatment to the configuration called Catenary.