Course Code: BSC101A

Course Title: Mathematics-1

Course Leader:

Programme	Course leader	E-mail ID
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Course Details

- Programme : **B. Tech. in Electronic & Communication, Computer Science, Electrical and Electronics, Mechanical and Civil Engineering**
- Department: **Mathematics**
- Faculty: **Science and Humanities**
- Dean: **Prof. M.R. Srinivasan (dean.sh@msruas.ac.in)**

Why this Programme - ME

1. To facilitate the understanding of underlying engineering principles of mechanical systems to explain their construction and working
2. To model, simulate and analyze the behavior of mechanical systems to predict and improve their performance
3. To design and fabricate mechanical systems to meet the specific needs
4. To instrument and test of mechanical systems for validation
5. To educate on professional ethics, economics, social sciences and interpersonal skills
6. relevant to professional practice
7. To provide a foundation in mathematical, scientific and Engineering & technology fundamentals to solve Engineering and Technology related problems
8. To provide a general perspective and opportunities for a career in industry, business and
9. Commerce

The Course is being delivered to meet the highlighted objective of the course to meet the course aim

Why this Programme – ECE

1. To impart knowledge on electronic and communication systems
2. To enhance the understanding of the underlying principles of electronic and communication systems
3. To develop abilities to design analog and digital system/controllers to meet the required specifications
4. To develop abilities to model, simulate and analyse the characteristics of electronic signals and systems
5. To train on computer programming abilities and skills
6. To train on industry standard simulation tools for simulation and analysis of electronic systems
7. To impart training on instrumentation, test and measurement
8. To build and test electronic systems
9. To provide a foundation in mathematical, scientific and engineering & technology fundamentals to solve engineering and technology related problems
10. To impart training on professional ethics, history, economics, social sciences and interactive skills relevant to professional practice
11. To provide a general perspective and opportunities for a career in industry, business and commerce

- **The Course is being delivered to meet the highlighted objective of the course to meet the course aim.**

Why this Programme – CSE

1. To impart knowledge of computing and information technology systems and their subsystems
2. To develop understanding of the underlying logical, algorithmic, architectural and programming principles of computing systems
3. To build the ability to design and implement computing and information systems to meet the specific application needs
4. To model, simulate and analyse the behaviour of computing and information systems to predict and improve their performance
5. To impart training on processes and practice of software engineering life cycle
6. To train on industry standard simulation tools for simulation and analysis of electronic systems
7. To develop industry standard software systems
8. To provide a foundation in mathematical, scientific and engineering & technology fundamentals to solve engineering and technology related problems
9. To impart training on professional ethics, history, economics, social sciences and interactive skills relevant to professional practice
10. To provide a general perspective and opportunities for a career in industry, business and commerce

- **The Course is being delivered to meet the highlighted objective of the course to meet the course aim.**

Why this Programme – EEE

1. To impart knowledge on electrical and electronic systems and their subsystems
2. To enhance the understanding of the underlying engineering principles of electrical and electronic systems
3. To model, simulate and analyze the behaviour of electrical and electronic systems to predict and improve their performance
4. To design and build models of electrical and electronic systems to meet the specific needs
5. To impart training on instrumentation and testing of electrical and electronic systems
6. To train on industry standard simulation tools for simulation and analysis of electrical and electronic systems
7. To build and test electrical and electronic systems
8. To provide a foundation in mathematical, scientific and engineering & technology fundamentals to solve engineering and technology related problems
9. To impart training on professional ethics, history, economics, social sciences and interactive skills relevant to professional practice
10. To provide a general perspective and opportunities for a career in industry, business and commerce

The Course is being delivered to meet the highlighted objective of the course to meet the course aim.

Why this Programme – CE

1. To Impart knowledge on civil engineering systems and their subsystems
2. To enhance the understanding of the underlying engineering principles of civil engineering systems
3. To model, simulate and analyze the behavior of civil engineering systems to predict and improve their performance
4. To design and build civil engineering systems to meet the specific needs
5. To impart training on instrumentation and testing of civil engineering systems
6. To train on computer programming abilities and skills
7. To build and test civil engineering systems
8. To provide a foundation in mathematical, scientific and engineering & technology fundamentals to solve engineering and technology related problems
9. To impart training on professional ethics, history, economics, social sciences and interactive skills relevant to professional practice
10. To provide a general perspective and opportunities for a career in civil engineering, business and commerce

- **The Course is being delivered to meet the highlighted objective of the course to meet the course aim.**

Subject Aim and Summary

The course introduces students to the basic concepts and techniques in real and complex analyses, matrix algebra and numerical analysis. Students are taught the concepts of derivative, continuity, limits, series expansion, functions and integrals of real and complex variables. The utility of Cauchy's Integral and residue theorem in the evaluation of an integral is emphasized. The mathematical operations in Matrix theory, Eigen value and Eigen vector, Inversion and diagonalization of matrix and matrix solution for linear system of equations are discussed in this course. This course also deals with the underlying concepts of finding the roots, solving the linear systems in the context of numerical analysis and implementation of the schemes in MATLAB.

Intended Learning Outcomes

After undergoing this course students will be able to:

1. Explain the principles of real and complex analysis
2. State and explain the important theorems and solve simple mathematical problems in real and complex analysis
3. Solve complex real world problems associated with real and complex analysis
4. Apply numerical methods to solve linear system of equations, algebraic and transcendental equations and implement the schemes in MATLAB
5. Solve complex mathematical problems associated with linear algebra and numerical solution of nonlinear equation in one variable and compare the results with that of solutions obtained using MATLAB

Course Content

- **Real Analysis:**

  Functions of real variables, limit of function, continuity and derivatives. Mean value theorems and their applications. Taylor's Theorem, Taylor's series and Maclaurin series, exponential, logarithmic and binomial series. Indefinite Integrals and definite Integrals, Improper integrals of first and second kind, Absolute Convergence of Improper integrals

  Functions of two variables – limits and continuity. Partial Derivatives – Total Differential and Derivatives, approximation by total differentials, Derivatives of Composite and Implicit functions. Higher order Partial Derivatives – Homogeneous functions and Euler's theorem, Taylor's Theorem, Maximum and Minimum Values of functions – Lagrange Method of Multipliers

Contd..

Course Content Contd..

- **Complex Analysis:**

  Complex Numbers, Complex Planes, Polar Form – Powers, Roots. Exponential Function, Trigonometric Functions, Hyperbolic Functions. Cauchy – Riemann Equations, Geometry of Analytic Functions and Harmonic Functions – Conformal Mapping, Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula.

  Power Series - Convergence. Taylor Series and Maclaurin Series. Laurent Series, Zeros and Singularities. Residue Integration Method.

Method of Assessment

There are two components for assessment in this Subject:

Component - 1: 50% weight

It has two sub components

- Part A: Term Test: 25% Weight
- Part B: Assignment: 25% Weight

Two tests will be conducted one at the end of 6th week and the other at the end of the 12th week, the average of two tests will be the marks scored in term test for a maximum of 25 marks.

Student is required to submit two word processed assignments each assignment is set for 50 marks, the average of two assignments will be the marks scored in assignment for a maximum of 25 marks.

Method of Assessment Cont.

Component - 2: 50% weight

A 2 hour duration semester end examination on Part-B using Matlab will be conducted for a maximum marks of 50 and will be reduced to 25 marks.

Another 2 hour duration semester end examination on Part-A will be conducted for maximum marks of 50 and will be reduced to 25 marks.

Method of Assessment Cont.

The assessment questions are set to test the learning outcomes. In each component certain learning outcomes are assessed. The following table illustrates the focus of learning outcome in each component assessed:

Intended Learning Outcome		1	2	3	4	5
Component – 1 (Term Test and Assignment)	A	X	X			
	B			X	X	X
Component – 2 (Examination)		X	X	X	X	X

Both components will be moderated by a second examiner. A student is required to score a minimum of 40% in each of the components and an overall 40% for successful completion of a module and earning the credits.

References

a. Essential Reading

1. Class Notes
2. Erwin Kreyszig (2007) Advanced Engineering Mathematics, Eighth Edition, John Wiley & Sons Inc.
3. R.K.Jain and S.R.K.Iyengar (2005) Advanced Engineering Mathematics, Second Edition, Narosa Publishing House
4. James Stewart (2010) Calculus: Early Transcendentals, 8^{th} edition, Cengage Learning
5. R. Pratap (2010), Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford
6. S.R. Otto and J.P. Denier (2008), An Introduction to Programming and Numerical Methods in MATLAB, Springer

b. Recommended Reading

1. Peter V.O'Neil, (2007) Advanced Engineering Mathematics, Cengage Learning India Pvt. Ltd
2. Glyn James, (2007) Advanced Modern Engineering Mathematics, Pearson Education
3. A. Stanoyevitch (2005), Introduction to Matlab with Numerical Preliminaries, Wiley

Course Delivery Schedule (Theory)

Number of Course Credits: 4 (3 Theory, 1 Tutorial)

Session No.	Date/ Week	Time	Day	Topic	Delivered By	Additional Activity
1	Week 1			Functions, Continuity and Derivative		
2	Week 1			Mean Value Theorems – Rolle's mean value theorem		
3	Week 1			Mean Value Theorems – Lagrange's mean value theorem		
4	Week 2			Mean Value Theorems – Cauchy's mean value theorem		
5	Week 2			Taylor's Theorem and Taylor's series		
6	Week 2			Maclaurin Series		
7	Week 3			Indefinite, Definite and Improper Integrals		
8	Week 3			Improper integrals of first and second kind		
9	Week 3			Absolute Convergence of Improper Integrals		
10	Week 4			Functions of two variables – limits and continuity		

Course Delivery Schedule (Theory)

Number of course Credits: 4 (3 Theory, 1 Tutorial)

Session No.	Date/Week	Time	Day	Topic	Delivered By	Additional Activity
11	Week 4			Partial Derivatives – Total Differential and Derivatives		
12	Week 4			Derivatives of Composite and Implicit functions - I		
13	Week 5			Derivatives of Composite and Implicit functions _ II		
14	Week 5			Homogeneous functions and Euler's theorem		
15	Week 5			Taylor's Theorem for function of two variables		
Week 6 1st term test						
16	Week 7			Maclaurin's Theorem for function of two variables		
17	Week 7			Maximum and Minimum Values of functions - I		
18	Week 7			Maximum and Minimum Values of functions - II		
19	Week 8			Lagrange Method of Multipliers - I		
20	Week 8			Lagrange Method of Multipliers - II		

Course Delivery Schedule (Theory)

Number of course Credits: 4 (3 Theory, 1 Tutorial)

Session No.	Date/ Week	Time	Day	Topic	Delivered By	Additional Activity
21	Week 8			Complex Variables		
22	Week 9			Trigonometric and hyperbolic functions		
23	Week 9			Limit, continuity and analytic functions		
24	Week 9			C-R Equations 1		
25	Week 10			Harmonic function and Milne method		
26	Week 10			C-R Equations in polar form		
27	Week 10			Conformal Mapping-1		
28	Week 11			Conformal Mapping-2		
29	Week 11			Conformal Mapping-3		
30	Week 11			Bilinear Mapping		

Course Delivery Schedule (Theory)

Number of course Credits: 4 (3 Theory, 1 Tutorial)

Session No.	Date/ week	Time	Day	Topic	Delivered By	Additional Activity
Week 12 2nd term test						
31	Week 13			Linear Integral - 1		
32	Week 13			Linear Integral - 2		
33	Week 13			Cauchy's integral formula		
34	Week 14			Cauchy's integral formula problems		
35	Week 14			Sequences and series		
36	Week 14			Power Series		
37	Week 15			Taylor Series and Maclaurin Series		
38	Week 15			Laurent series		
39	Week 15			Singularities and zeros		
40	Week 16			Residue Integration Theorem		

Theory Sessions

Lecture 1
Functions of Real Variable, Limit of Function, Continuity and Derivatives

Intended Learning Outcomes

- Analyze real valued functions and plot the same
- Illustrate the concepts of limit , continuity and differentiability of a real valued function

Lecture 2
Rolle's Mean Value Theorem

Intended Learning Outcomes

- State and Rolle's mean value theorem
- Discuss the geometrical interpretation of this theorem
- Apply Rolle's mean value theorems to specific problems

Lecture 3
Lagrange's Mean Value Theorem

Intended Learning Outcomes

- State Lagrange's mean value theorem
- Discuss the geometrical interpretation of this theorem
- Apply Lagrange's mean value theorems to specific problems

Lecture 4
Cauchy’s Mean Value Theorem

Intended Learning Outcomes

- State Cauchy’s mean value theorem

- Apply Cauchy’s mean value theorem to specific problems

Lecture 5

Taylor's Theorem and Taylor's Series

Intended Learning Outcomes

- State and construct Taylor's Theorem
- Apply Taylor Series to expand standard functions

Lecture 6
Maclaurin's Series
Intended Learning Outcomes

- State and construct Maclaurin Series
- State Exponential, Logarithmic and Binomial Series
- Apply Maclaurin's Series to expand standard functions

Lectures 7-8
Indefinite, Definite and Improper Integrals, Absolute Convergence

Intended Learning Outcomes

- Distinguish between indefinite integrals and definite integrals
- Differentiate between proper and improper integrals
- Classify and evaluate improper integrals

Lecture 9
Absolute Convergence of Improper Integrals

Intended Learning Outcomes

- Illustrate absolute convergence
- Analyse and test the convergence of improper integrals

Lectures 10 -11

Partial Derivatives-limits and Continuity, Total differentiation and Derivatives

Intended Learning Outcomes

- Illustrate the principals of limit and continuity of functions of two variables
- Illustrate the principal of partial derivatives of functions of two variables
- Apply the concepts of total derivatives in errors and approximations

Lectures 12-13
Derivatives of Composite and Implicit Functions

Intended Learning Outcomes

- Define composite and implicit functions
- Find derivatives of composite functions and implicit functions
- Evaluate higher order partial derivatives

Lecture 14
Homogenous functions and Euler’s Theorem

Intended Learning Outcomes

- Illustrate homogeneous functions
- Verify Euler’s theorem for Homogeneous functions

Lectures 15-16

Taylor's and McLaurin's Theorem for Two Variables

Intended Learning Outcomes

- Distinguish between Euler's and Taylor's theorem
- Extend Taylor's theorem to functions of two variables

Lecture 17

Maximum and Minimum Values of Functions_I

Intended Learning Outcomes

- Define and explain the significance of maxima and minima
- Determine the maximum and minimum of a function at different points

Lecture 18

Maximum and Minimum values of Functions_II

Intended Learning Outcomes

- Define and explain the significance of maxima and minima
- Determine the maximum and minimum of a function at different points

Lecture 19
Lagrange's Method of Multipliers_I

Intended learning Outcomes

- State and explain Lagrange Method of Multipliers

- Apply the Lagrange Method of Multipliers to maximize/minimize the given function subject to equality constraints

Lecture 20
Lagrange's Method of Multipliers_II

Intended learning Outcomes

- State and explain Lagrange Method of Multipliers
- Apply the Lagrange Method of Multipliers to maximize/minimize the given function subject to equality constraints

Lecture 21
Complex Variables

Intended learning Outcomes

- State different forms to represent a complex number
- Explain the advantages and applications of different forms
- State DeMoivres theorem
- Apply DeMoivres theorem to find powers and roots of complex variable

Lecture 22
Trigonometric and Hyperbolic Functions

Intended Learning Outcomes

- Explain the trigonometric and hyperbolic functions
- Express the complex function in terms of polar and Cartesian form

Lecture 23

Limit, Continuity and Analytic Functions

Intended Learning Outcomes

- State Limit and continuity
- State analytic functions

Lecture 24
Cauchy-Riemann Equation_1

Intended learning Outcomes

- State mathematical statement of analytic function
- State and prove the Cauchy-Riemann equations in Cartesian and polar form
- Apply Cauchy-Riemann equations to verify the analyticity of complex valued functions

Lecture 25
Harmonic functions and Milne Method

Intended Learning Outcomes

- State Harmonic function
- Apply Milne method to construct an analytic function
- Illustrate harmonic function and discuss its properties
- State Orthogonal System

Lecture 26

Cauchy-Riemann Equation in Polar Form

Intended learning Outcomes

- State Cauchy-Riemann equations for analytic function in polar form
- Apply Cauchy-Riemann equations to verify the analyticity of complex valued functions
- Illustrate harmonic function and discuss its properties

Lecture 27
Conformal Mapping_1

Intended Learning Outcomes

- Find conformal mappings
- Solve application oriented problems using conformal mappings

Lecture 28
Conformal Mapping_2

Intended learning Outcomes

- Illustrate conformal mapping
- Discuss the properties of standard conformal mappings
- Solve application oriented problems using conformal mappings

Lecture 29
Conformal Mapping -3

Intended learning Outcomes

- Illustrate conformal mapping
- Discuss the properties of standard conformal mappings

Lecture 30
Bilinear Transformation

Intended Learning Outcomes

- Find the Bilinear Transformation

- Solve application oriented problems using Bilinear Transformation

Lecture 31
Line Integral-1

Intended Learning Outcomes

- Define line integral in complex plane
- Solve problems on line integral

Lecture 32
Line Integral -2

Intended Learning Outcomes

At the end of this lecture, student will be able to:

- Define line integral in complex plane
- Solve problems on line integral

Lecture 33
Cauchy’s Integral Formula-1

Intended learning Outcomes

- State Cauchy’s integral theorem and its utility
- Apply Cauchy’s integral theorem to evaluate complex integrals

Lecture 34
Cauchy's Integral Formula problems

Intended learning Outcomes

- Apply Cauchy's integral to evaluate complex integrals

Lecture 35

Sequences, Series and Convergence Tests

Intended Learning Outcomes

- Differentiate between sequence and series of complex numbers
- Explain the tests to verify convergence of a sequence/series
- Apply the standard tests to test and verify the convergence of complex sequence/series

Lecture 36
Power Series

Intended learning Outcomes

- Analyze various power series
- Evaluate the radius of convergence of power series

Lecture 37
Taylor Series, Maclaurin Series and Uniform Convergence

Intended Learning Outcomes

- Formulate an expansion of a complex valued function through Taylor and Maclaurin series

- Distinguish between convergence and uniform convergence

- Determine the uniform convergence of Taylor and Maclaurin series

Lecture 38
Laurent Series
Intended Learning Outcomes

- Define meromorphic function
- State Laurent's theorem
- Expand some meromorphic functions in Laurent series

Lecture 39

Singularities, Zeros, Poles and Residues

Intended Learning Outcomes

- Classify singularities of complex valued functions
- Describe the concept of zero and infinity
- Define residue at a singularity of the complex valued function
- Apply Laurent series to find the residue

Lecture 40
Residue Integration Method

Intended learning Outcomes

- State and explain Cauchy’s residue theorem
- Evaluate some complex integrals using Cauchy’s residue theorem