Course Title:	**Mathematics-I for Civil Engineering stream**		
Course Code:	**BMAC101C**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 Lab slots	Credits	04

Course objectives: The goal of the course **Mathematics-I for Civil Engineering stream**(**BMAC101C**) is to

- **Familiarize** the importance of calculus associated with one variable and two variables for Civil engineering.
- **Analyze** Civil engineering problems applying Ordinary Differential Equations.
- **Develop** the knowledge of Linear Algebra referring to matrices.

Module-1:Calculus **(8 hours)**

Introduction to polar coordinates and curvature relating to Civil engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, and angle between two curves. Pedal equations. Curvature and Radius of curvature – Cartesian and Polar (with proof), Parametric and Pedal forms (without proof)- Problems.

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Structural design and paths, Strength of materials, Elasticity.
(RBT Levels: L1, L2 and L3)

Module-2:
Series Expansion and Multivariable Calculus **(8 hours)**

Introduction to series expansion and partial differentiation in the field of Civil engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule, problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables - Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.
Applications: Computation of stress and strain, Errors and approximations, Estimating the critical points and extreme values.
(RBT Levels: L1, L2 and L3)

Module-3: First order ODE and Infinite Series (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Civil engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations Integrating factors on 1/N(∂M / ∂y- ∂N/ ∂x) and 1/M(∂N / ∂x- ∂M/ ∂y), Orthogonal trajectories and Newton's law of cooling.

Infinite Series: Introduction, convergence, divergence and oscillation of an infinite series, comparison test, p-series, D'Alemberts ratio test and Raabes test(all tests without proof).

Self-Study: Applications of ODEs in Civil Engineering problems like bending of the beam, whirling of shaft, solution of non-linear ODE by the method of solvable for p, x and y. Clairaut's equations - Problems**.**
Applications: Rate of Growth or Decay, Conduction of heat.
(RBT Levels: L1, L2 and L3)

Module-4:Ordinary Differential Equations of Higher Order (8 hours)

Importance of higher-order ordinary differential equations in Civil engineering applications.

Higher-order linear ODEs with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations -Problems.

Self-Study: Formulation and solution of Cantilever beam. Finding the solution by the method of undetermined coefficients.

Applications: Oscillations of a spring, Transmission lines, Highway engineering.
(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Civil engineering applications.

Elementary row transformation of a matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method, approximate solution by Gauss-Seidel method. Eigen values and Eigenvectors, Rayleigh's power method to find the dominant Eigen value and Eigenvector.

Self-Study: Solution of a system of linear equations by Gauss-Jacobi iterative method and Gauss-Jordan method. Inverse of a square matrix by Cayley- Hamilton theorem.
Applications: Structural Analysis, Balancing equations.
(RBT Levels: L1, L2 and L3)

List of Laboratory experiments (2 hours/week per batch/ batch strength 15) 10 lab sessions

1. To compute Area, Surface area and volume.
2. 2D Plots for Cartesian curves
   i. Plot of parabola
   ii. $y=x^2$ and $y=\sin(x)$, $y=\tan(x)$
   iii. Plot of Perfect parabola $y=x^2$
   iv. Change the color (Green) of perfect color perfect parabola
   v. Change the color (Red) of perfect color perfect parabola
   vi. Draw a red color with ' - -' perfect parabola
   vii. Draw a red color with ' *' perfect parabola
   viii. Draw a red color with axes label perfect parabola
   ix. Draw a perfect parabola with animation
   x. Draw parametric curves cycloid
   xi. $x=a(t+\sin t)$,$y=a(1+\cos t)$
   xii. $x = a(t - \sin t)$; $y = a (1-\cos t)$
   xiii. $x=a(t-\sin t)$; $y=a(1+\cos t)$
   xiv. $x=a(t + \sin t)$, $y=a(1-\cos t)$
   xv. x=t^2 , $y=t-(t^3/3)$
3. 2D Plots for Polar curves
   i. Cardiod $r = a+b\cos\theta$
   ii. Cardiod $r=a+b\cos\theta$, if $a>b$
   iii. Cardiod $r = a+b\cos\theta$, if $b>a$
   iv. Draw polar petals $r = 2\cos4\theta$
   v. $R=2\cos\theta$, $r=2\cos7\theta$, $r=2\cos6\theta$, $r=2\cos5\theta$
   vi. Cardoid $r=a(1+\cos\theta)$
   vii. Cardoid $r=a(1-\cos\theta)$
   viii. Draw histogram curves
4. Finding curvature and radius of curvature of a given point
5. Finding partial derivatives and Jacobian
6. Solution of first-order ordinary differential equation and plotting the solution curves

7. Find the rank of a matrix
8. Numerical solution of system of linear equations, test for consistency and graphical representation
9. Solution of system of linear equations using Gauss-Seidel iteration
10. Compute Eigen values and eigenvectors and find the largest and smallest Eigen value by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1: apply the knowledge of calculus to solve problems related to polar curves.

CO2: to learn the notion of partial differentiation to compute rate of change of multivariate functions.

CO3: analyze the solution of linear and nonlinear ordinary differential equations.

CO4: analyze the solution of Infinite series and familiarize with modern mathematical tools namely SCILAB

CO5: make use of matrix theory for solving the system of linear equations and compute Eigen values and Eigen vectors.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7thEd., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.

Course Title:	**Mathematics-I for Electrical & Electronics Engineering Stream**		
Course Code:	**BMAE101C**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 Lab slots	Credits	04

Course objectives: The goal of the course **Mathematics-I for Electrical & Electronics Engineering stream**(**BMAE101C**) is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for Electrical and Electronics engineering.
- **Analyze** Electrical and Electronics engineering problems by applying Ordinary Differential Equations.
- **Familiarize** the important tools in Integral Calculus that are essential in Electrical and Electronics engineering.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Module-1:Calculus (8 hours)

Introduction to polar coordinates and curvature relating to EC & EE Engineering applications.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian and Polar (with proof), Parametric and Pedal forms (without proof)- Problems.

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Communication signals, Manufacturing of microphones, and Image processing.
(RBTLevels:L1,L2andL3)

Module-2:Series Expansion and Multivariable Calculus (8 hours)

Introduction of series expansion and partial differentiation in EC&EE Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only)–problems. Indeterminate forms - L'Hospital's rule - Problems.

Partial differentiation, total derivative-differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Self-study: Euler's Theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.
Applications: Series expansion in communication signals, Errors and approximations, and vector calculus.
(RBTLevels:L1,L2andL3)

Module-3: First order ODE and Infinite Series (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for EC & EE engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations Integrating factors on 1/N(**∂***M* / **∂**y- **∂**N/ **∂**x) and 1/M(**∂**N / **∂**x- **∂**M/ **∂**y), Orthogonal trajectories, L-R and C-R circuits. Problems

Infinite Series: Introduction, convergence, divergence and oscillation of an infinite series, comparison test, p-series, D'Alemberts ratio test and Raabes test(all tests without proof).

Self-Study: Applications of ODEs, Alternating Series, solution of non-linear ODE by the method of solvable for p, x and y. Clairaut's equations - Problems**.**
Applications: Rate of Growth or Decay, Conduction of heat.
(RBT Levels: L1, L2 and L3)

Module-4:IntegralCalculus(8hours)

Introduction to Integral Calculus in EC & EE Engineering applications.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Surface area. Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Volume by multiple integration, Center of gravity.
Applications: Antenna and wave propagation, Calculation of optimum power in electrical circuits, field theory.
(RBTLevels:L1,L2andL3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to EC&EE Engineering applications.

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, approximate solution by Gauss-Seidel method. Eigen values and Eigenvectors, Rayleigh's power method to find the dominant Eigen value and Eigenvector.

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method, Gauss-Jordan method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications of Linear Algebra: Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.
(RBTLevels:L1,L2andL3)

List of Laboratory experiments (2 hours/week per batch/ batch strength 15)

10 lab sessions

1. To compute Area, Surface area and volume.
2. 2D Plots for Cartesian curves
   i. Plot of parabola
   ii. $y=x^2$,and $y=\sin x$,$y=\tan x$
   iii. Plot of Perfect parabola $y=x^2$
   iv. Change the color (Green) of perfect color perfect parabola
   v. Change the color (Red) of perfect color perfect parabola
   vi. Draw a red color with ' - -' perfect parabola
   vii. Draw a red color with ' *' perfect parabola
   viii. Draw a red color with axes label perfect parabola
   ix. Draw a perfect parabola with animation
   x. Draw parametric curves cycloid
   xi. $x=a(t+\sin t)$,$y=a(1+\cos t)$
   xii. $x = a(t - \sin t)$; $y = a (1-\cos t)$
   xiii. $x=a(t-\sin t)$; $y=a(1+\cos t)$
   xiv. $x=a(t + \sin t)$, $y=a(1-\cos t)$
   xv. x=t^2 , $y=t-(t^3/3)$
3. 2D Plots for Polar curves
   i. Cardiod $r = a+b\cos\theta$
   ii. Cardiod $r=a+b\cos\theta$, if $a>b$
   iii. Cardiod $r = a+b\cos\theta$, if $b>a$
   iv. Draw polar petals $r = 2\cos4\theta$
   v. $R=2\cos\theta$, $r=2\cos7\theta$, $r=2\cos6\theta$, $r=2\cos5\theta$
   vi. Cardoid $r=a(1+\cos\theta)$
   vii. Cardoid $r=a(1-\cos\theta)$
   viii. Draw histogram curves
4. Finding curvature and radius of curvature of a given point
5. Finding partial derivatives and Jacobian
6. Solution of first-order ordinary differential equation and plotting the solution curves
7. Find the rank of a matrix
8. Numerical solution of system of linear equations, test for consistency and graphical representation
9. Solution of system of linear equations using Gauss-Seidel iteration
10. Compute Eigen values and eigenvectors and find the largest and smallest Eigen value by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1: apply the knowledge of calculus to solve problems related to polar curves.

CO2: to learn the notion of partial differentiation to compute rate of change of multivariate functions.

CO3: analyze the solution of ordinary differential equations and Infinite series.

CO4: apply the concept of change of order of integration and variables to evaluate multiple integrals and familiarize with modern mathematical tools namely SCILAB

CO5: make use of matrix theory for solving the system of linear equations and compute Eigen values and Eigen vectors.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7thEd., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.

Course Title:	**Mathematics-I for Mechanical Engineering stream**		
Course Code:	**BMAM101C**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 Lab slots	Credits	04

Course objectives: The goal of the course **Mathematics-I for Mechanical Engineering stream**(**BMAM101C**) is to

- **Familiarize** the importance of calculus associated with one variable and two variables for Mechanical engineering.
- **Analyze** Mechanical engineering problems applying Ordinary Differential Equations.
- **Develop** the knowledge of Linear Algebra referring to matrices.

Module-1:Calculus **(8 hours)**

Introduction to polar coordinates and curvature relating to Mechanical engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian and Polar (with proof), Parametric and Pedal forms (without proof)- Problems.

Self-study: Center and circle of curvature, evolutes and involutes.

Applications: Applied Mechanics, Strength of Materials, Elasticity.

(RBT Levels: L1, L2 and L3)

Module-2:Series Expansion and Multivariable Calculus **(8 hours)**

Introduction to series expansion and partial differentiation in the field of Mechanical engineering applications.

Taylor**'**s and Maclaurin**'**s series expansion for one variable (Statement only) **–** problems. Indeterminate forms - L'Hospital**'**s rule, Problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables-Problems.

Self-study: Euler**'**s theorem and problems. Method of Lagrange**'**s undetermined multipliers with a single constraint.

Applications: Computation of stress and strain, Errors and approximations in manufacturing process, Estimating the critical points and extreme values, vector calculus.

(RBT Levels: L1, L2 and L3)

Module-3: First order ODE and Infinite Series (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Mechanical engineering

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations Integrating factors on $1/N(\partial M/\partial y - \partial N/\partial x)$ and $1/M(\partial N/\partial x - \partial M/\partial y)$, Orthogonal trajectories, L-R and C-R circuits. Problems

Infinite Series: Introduction, convergence, divergence and oscillation of an infinite series, comparison test, p-series, D'Alemberts ratio test and Raabes test(all tests without proof).

Self-Study: Applications of ODEs, Alternating Series, solution of non-linear ODE by the method of solvable for p, x and y. Clairaut's equations - Problems**.**

Applications: Rate of Growth or Decay, Conduction of heat.

(RBT Levels: L1, L2 and L3)

Module-4:Ordinary Differential Equations of Higher Order (8 hours)

Importance of higher-order ordinary differential equations in Mechanical engineering applications.

Higher-order linear ODEs with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy**'**s and Legendre homogeneous differential equations - Problems.

Self-Study: Formulation and solution of oscillations of a spring. Finding the solution by the method of undetermined coefficients.

Applications: Applications to oscillations of a spring, Mechanical systems and Transmission lines.

(RBT Levels: L1, L2 and L3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Mechanical engineering applications.

Elementary row transformation of a matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method, approximate solution by Gauss-Seidel method. Eigen values and Eigenvectors, Rayleigh**'**s power method to find the dominant Eigen value and Eigenvector.

Self-Study: Solution of a system of equations by Gauss-Jacobi iterative method. Gauss-Jordan method, Inverse of a square matrix by Cayley- Hamilton theorem

Applications of Linear Algebra: Network Analysis, Balancing equations.

(RBT Levels: L1, L2 and L3)

List of Laboratory experiments (2 hours/week per batch/ batch strength 15)
10 lab sessions

1. To compute Area, Surface area and volume.
2. 2D Plots for Cartesian curves
   i. Plot of parabola
   ii. $y=x^2$,and $y=\sin x$,$y=\tan x$
   iii. Plot of Perfect parabola $y=x^2$
   iv. Change the color (Green) of perfect color perfect parabola
   v. Change the color (Red) of perfect color perfect parabola
   vi. Draw a red color with ' - -' perfect parabola
   vii. Draw a red color with ' *' perfect parabola
   viii. Draw a red color with axes label perfect parabola
   ix. Draw a perfect parabola with animation
   x. Draw parametric curves cycloid
   xi. $x=a(t+\sin t)$,$y=a(1+\cos t)$
   xii. x = a(t – sint); y = a (1-cost)
   xiii. x=a(t-sint); y=a(1+cost)
   xiv. x=a(t + sint), y=a(1-cost)
   xv. x=t^2 , y=t-(t^3/3)
3. 2D Plots for Polar curves
   i. Cardiod r = a+b cosθ
   ii. Cardiod r=a+bcosθ, if a>b
   iii. Cardiod r = a+b cosθ, if b>a
   iv. Draw polar petals r = 2 cos4θ
   v. R=2cosθ, r=2cos7θ, r=2 cos6θ, r=2cos5θ
   vi. Cardoid $r=a(1+\cos\theta)$
   vii. Cardoid $r=a(1-\cos\theta)$
   viii. Draw histogram curves
4. Finding curvature and radius of curvature of a given point
5. Finding partial derivatives and Jacobian
6. Solution of first-order ordinary differential equation and plotting the solution curves
7. Find the rank of a matrix
8. Numerical solution of system of linear equations, test for consistency and graphical representation
9. Solution of system of linear equations using Gauss-Seidel iteration
10. Compute Eigen values and eigenvectors and find the largest and smallest Eigen value by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1: apply the knowledge of calculus to solve problems related to polar curves.

CO2: to learn the notion of partial differentiation to compute rate of change of multivariate functions

CO3: analyze the solution of ordinary differential equations and Infinite series.

CO4: analyze the solution of higher order ODE and familiarize with modern mathematical tools namely SCILAB

CO5 : make use of matrix theory for solving the system of linear equations and compute Eigen values and eigenvectors.

Suggested Learning Resources:
Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.

Course Title:	**Mathematics-I for Computer Science and Engineering stream**		
Course Code:	**BMAS101C**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 Lab slots	Credits	04

Course objectives: The goal of the course **Mathematics-I for Computer Science and Engineering stream**(**BMAS101C**) is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for computer science and engineering.
- **Analyze** Computer science and engineering problems by applying Ordinary Differential Equations.
- **Apply** the knowledge of modular arithmetic to computer algorithms.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Module-1:Calculus **(8 hours)**

Introduction to polar coordinates and curvature relating to Computer Science and Engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian and Polar (with proof), Parametric and Pedal forms (without proof)- Problems.

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Computer graphics, Image processing.
(RBTLevels:L1,L2andL3)

Module-2:Series Expansion and Multivariable Calculus **(8 hours)**

Introduction to series expansion and partial differentiation in Computer Science& Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule, Problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables-Problems.

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with a single constraint.
Applications: Series expansion in computer programming, Computing errors and approximations.
(RBT Levels: L1, L2 and L3)

Module-3: First order ODE and Infinite Series (8 hours)

Introduction to first-order ordinary differential equations pertaining to the applications for Computer Science & Engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations Integrating factors on $1/N(\partial M/\partial y - \partial N/\partial x)$ and $1/M(\partial N/\partial x - \partial M/\partial y)$, Orthogonal trajectories, L-R and C-R circuits. Problems

Infinite Series: Introduction, convergence, divergence and oscillation of an infinite series, comparison test, p-series, D'Alemberts ratio test and Raabes test (all tests without proof).

Self-Study: Applications of ODEs, Alternating Series, solution of non-linear ODE by the method of solvable for p, x and y. Clairaut's equations - Problems**.**
Applications: Rate of Growth or Decay, Conduction of heat.
(RBT Levels: L1, L2 and L3)

Module-4:Modular Arithmetic (8hours)

Introduction of modular arithmetic and its applications in Computer Science and Engineering.

Introduction to Congruence, Linear Congruence, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruence's, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruence-RSA algorithm.

Self-Study: Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic.
Applications: Cryptography, encoding and decoding, RSA applications in public key encryption.
(RBTLevels:L1,L2andL3)

Module-5: Linear Algebra (8 hours)

Introduction of linear algebra related to Computer Science & Engineering.

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, approximate solution by Gauss-Seidel method. Eigen values and Eigenvectors, Rayleigh's power method to find the dominant Eigen value and Eigenvector.

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method and Gauss-Jordan method. Inverse of a square matrix by Cayley- Hamilton theorem.

Applications: Boolean matrix, Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.
(RBT Levels: L1, L2 and L3).

List of Laboratory experiments (2 hours/week per batch/ batch strength 15)
10 lab sessions

1. To compute Area, Surface area and volume.
2. 2D Plots for Cartesian curves
   i. Plot of parabola
   ii. $y=x^2$,and $y=\sin x$,$y=\tan x$
   iii. Plot of Perfect parabola $y=x^2$
   iv. Change the color (Green) of perfect color perfect parabola
   v. Change the color (Red) of perfect color perfect parabola
   vi. Draw a red color with ' - -' perfect parabola
   vii. Draw a red color with ' *' perfect parabola
   viii. Draw a red color with axes label perfect parabola
   ix. Draw a perfect parabola with animation
   x. Draw parametric curves cycloid
   xi. $x=a(t+\sin t)$,$y=a(1+\cos t)$
   xii. $x = a(t - \sin t)$; $y = a (1-\cos t)$
   xiii. $x=a(t-\sin t)$; $y=a(1+\cos t)$
   xiv. $x=a(t + \sin t)$, $y=a(1-\cos t)$
   xv. x=t^2 , $y=t-(t^3/3)$
3. 2D Plots for Polar curves
   i. Cardiod $r = a+b \cos\theta$
   ii. Cardiod $r=a+b\cos\theta$, if $a>b$
   iii. Cardiod $r = a+b \cos\theta$, if $b>a$
   iv. Draw polar petals $r = 2 \cos 4\theta$
   v. $R=2\cos\theta$, $r=2\cos 7\theta$, $r=2 \cos 6\theta$, $r=2\cos 5\theta$
   vi. Cardoid $r=a(1+\cos\theta)$
   vii. Cardoid $r=a(1-\cos\theta)$
   viii. Draw histogram curves
4. Finding curvature and radius of curvature of a given point
5. Finding partial derivatives and Jacobian
6. Solution of first-order ordinary differential equation and plotting the solution curves
7. Find the rank of a matrix

8. Numerical solution of system of linear equations, test for consistency and graphical representation
9. Solution of system of linear equations using Gauss-Seidel iteration
10. Compute Eigen values and eigenvectors and find the largest and smallest Eigen value by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1: apply the knowledge of calculus to solve problems related to polar curves.
CO2: to learn the notion of partial differentiation to compute rate of change of multivariate functions.
CO3: analyze the solution of ordinary differential equations and Infinite series.
CO4: get acquainted and to apply modular arithmetic to computer algorithms and familiarize with modern mathematical tools namely SCILAB
CO5 : make use of matrix theory for solving the system of linear equations and compute Eigen values and eigenvectors

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7thEd., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.