B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU, Belagavi

DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FIRST SEMESTER B. E.

Course Title	Mathematical Foundation for Civil Engineering – 1	Course Code	22MA1BSMCV
Credits	04	L – T – P	2-1-1

Course Objectives:

The objectives of the course are to facilitate the learners to

- **Appreciate** the importance of Calculus and Matrix theory in Civil Engineering.
- **Gain the knowledge** of Calculus and Matrix theory concepts to implement them in their core domain.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT - 1	**[08 hours]**

Calculus of One Variable:

Introduction to polar coordinates, polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature – Cartesian, Polar forms.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**

Multivariable Calculus

Partial differentiation, total derivative - differentiation of composite functions, Jacobian, Taylor's and Maclaurin's series expansion for two variables (statement only) – problems.

Applications: Errors and approximations, Maxima and minima for a function of two variables.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 3	**[08 hours]**

Ordinary Differential Equations of First Order

Introduction to first order ordinary differential equations. Bernoulli's differential equations. Exact and reducible to exact differential equations- Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$.

Applications: Mixing problem, Orthogonal trajectories.

Self-Study: Nonlinear differential equations - Introduction to general and singular solutions, solvable for p, for x and y. Clairaut's equations.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 4	**[08 hours]**

Ordinary Differential Equations of Higher Order

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

Applications: Oscillations of a spring-mass system.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 5	**[08 hours]**

Matrices and System of equations

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. Eigenvalues and eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Applications: Balancing chemical equations, traffic flow.

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

(RBT Levels: L1, L2 and L3)

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Teaching-Learning Process	Chalk and talk method / Power Point Presentation

List of Lab Programs

Weekly: 1 Session (2 hours) **Batch strength :15 students**

Number of Labs: 12 (10 Sessions+2 Lab Assessments)

1. Introduction to Python: Installation of packages and Modules, Variables, Lists, Tuples, Strings and Dictionaries.
2. Control statements and Looping statements, Introduction to Numpy, Sympy and Matplotlib.
3. 2D plots for Cartesian and polar curves.
4. Finding angle between polar curves, curvature and radius of curvature of a given curve.
5. Finding partial derivatives and Jacobian of multivariable functions.
6. Applications to Maxima and Minima of two variables.
7. Solving the first and second order differential equations with initial/boundary conditions and visualising their solutions.
8. Solution of a differential equation of oscillations of a spring/deflection of a beam with different loads.
9. Solving the system of linear equations using Gauss-Elimination and Gauss-Seidel Method.
10. Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Suggested software: Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA1BSMCV	CO 1	Apply the concepts of Calculus and Matrix theory in solving problems.	1	3
	CO 2	Relate the importance of Calculus and Matrix theory concepts to Civil engineering.	1	1
	CO 3	Demonstrate the understanding of Calculus and Matrix theory concepts through programming skills using modern tool - Python.	1,5,10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
CIE – Theory	Quiz/AAT	10	90	50	25	10	50
	Test 1	40					
	Test 2	40					
	Test 3	40					
CIE – Lab	Record & Performance	100	120	10	25	10	
	Lab Test	15		15			
CIE				50		**20**	
SEE	End Exam	100		50		35	50
Grand Total Marks						**40**	**100**

Two best scores out of the three tests will be considered for CIE.
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 1, 3, 5 and two questions each from Unit 2 and Unit 4.

Suggested Learning Resources:

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.
3. **D. C. Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
4. **C.R. Severance**: "Python for Everybody: Exploring Data Using Python 3", 1st edition, University of Michigan, 2016.
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10. **C. Jackson,** "Learning to Program using Python", Packt Publishing, 2nd edition, 2018.

Web links and Video Lectures (e-Resources):

1. Calculus of one and multivariable: https://nptel.ac.in/courses/111104092
2. Differential Equations: https://www.classcentral.com/course/differential-equations-engineers-13258 and https://nptel.ac.in/courses/111106100
3. Matrices and System of Equations:https://www.classcentral.com/course/matrix-algebra-engineers-11986 and https://nptel.ac.in/courses/111106051
4. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&search_language=English&page=1

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FIRST SEMESTER B. E. (ME, IEM, AS, CH)

Course Title	Mathematical foundation for Mechanical Engineering stream- 1	Course Code	22MA1BSMME
Credits	4	L – T – P	2-1-1

Course Objectives:

The objectives of the course are to facilitate the learners to

- **Appreciate** the importance of Calculus and matrix theory in Mechanical Engineering Stream.
- **Gain the knowledge** of Calculus and Matrix theory concepts to implement them in their core domain.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT - 1	**[08 hours]**

Calculus of One Variable:

Introduction to polar coordinates, polar curves, angle between the radius vector and tangent, angle between two curves.

Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**

Multivariable Calculus

Partial differentiation, total derivative - differentiation of composite functions, Jacobian, Taylor's and Maclaurin's series expansion for two variables (statement only) – problems.

Applications: Errors and approximations, Maxima and minima for a function of two variables.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 3	**[08 hours]**

Ordinary Differential Equations of First Order

Introduction to first order ordinary differential equations. Bernoulli's differential equations. Exact and reducible to exact differential equations- Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$.

Applications: Mixing problem, Orthogonal trajectories.

Self-Study: Nonlinear differential equations - Introduction to general and singular solutions, solvable for p, for x and y. Clairaut's equations.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT- 4	**[08 hours]**

Ordinary Differential Equations of Higher Order

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

Applications: Oscillations of a spring-mass system.

Self-Study: Finding the solution by the method of undetermined coefficients.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 5	**[08 hours]**

Matrices and System of equations

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. Eigenvalues and eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Applications: Balancing chemical equations, traffic flow.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

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DEPARTMENT OF MATHEMATICS

List of Lab Programs

Weekly: 1 Session (2 hours) **Batch strength :15 students**

Number of Labs: 12 (10 Sessions+2 Lab Assessments)

1. Introduction to Python: Installation of packages and Modules, Variables, Lists, Tuples, Strings and Dictionaries.
2. Control statements and Looping statements, Introduction to Numpy, Sympy and Matplotlib.
3. 2D plots for Cartesian and polar curves.
4. Finding angle between polar curves, curvature and radius of curvature of a given curve.
5. Finding partial derivatives and Jacobian of multivariable functions.
6. Applications to Maxima and Minima of two variables.
7. Solving the first and second order differential equations with initial/boundary conditions and visualising their solutions.
8. Solution of a differential equation of oscillations of a spring - mass system with different loads.
9. Solving the system of linear equations using Gauss-Elimination and Gauss-Seidel Method.
10. Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Suggested software : Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA1BSMME	**CO 1**	Apply the concepts of Calculus and Matrix theory in solving problems.	1	3
	CO 2	Relate the importance of Calculus and Matrix theory concepts to Mechanical engineering stream.	1	1
	CO 3	Demonstrate the understanding of Calculus and Matrix theory concepts through programming skills using modern tool - Python.	1,5,10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
CIE – Theory	Quiz/AAT	10		50	25	10	50
	Test 1	40	90				
	Test 2	40					
	Test 3	40					
CIE – Lab	Record & Performance	100	120	10	25	10	
	Lab Test	15		15			
CIE				50		**20**	
SEE	End Exam	100		50		35	50
Grand Total Marks						**40**	**100**

Two best scores out of the three tests will be considered for CIE.
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 1, 3, 5 and two questions each from Unit 2 and Unit 4.

Suggested Learning Resources:

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3. Matrices and System of Equations: https://www.classcentral.com/course/matrix-algebra-engineers-11986 and https://nptel.ac.in/courses/111106051
4. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&search_language=English&page=1

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FIRST SEMESTER B. E. (EEE, ETE, ECE, MD, EIE)

Course Title	Mathematical foundation for Electrical stream - 1	Course Code	22MA1BSMES
Credits	4	L – T – P	2 – 1 – 1

Course objectives:

The objectives of the course are to facilitate the learners to

- **Appreciate** the importance of calculus and matrix theory in allied engineering science
- **Gain the knowledge** of calculus and matrix theory concepts to implement them in their core domain
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT -1	**[08 hours]**

Calculus of One Variable

Introduction to polar coordinates, polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations.

Curvature and Radius of curvature - Cartesian, Parametric, Polar forms.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**

Multivariable Calculus

Partial differentiation, total derivative - differentiation of composite functions, Jacobian, Taylor's and Maclaurin's series expansion for two variables (statement only) – problems.

Applications: Errors and approximations, Maxima and minima for a function of two variables.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT- 3	**[08 hours]**

Ordinary Differential Equations of First Order

Introduction to first order ordinary differential equations. Bernoulli's differential equations. Exact and reducible to exact differential equations- Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$.

Applications: L-R circuits. Orthogonal trajectories.

Self-Study: Nonlinear differential equations- Introduction to general and singular solutions, solvable for p, for x and y. Clairaut's equations.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 4	**[08 hours]**

Ordinary Differential Equations of Higher Order

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

Application: LRC series circuit.

Self-Study: Finding the solution by the method of undetermined coefficients.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 5	**[08 hours]**

Matrices and System of equations

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. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. Problems

Applications of Linear Algebra: Mesh current, traffic flow.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

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4. Finding angle between polar curves, curvature and radius of curvature of a given curve.
5. Finding partial derivatives and Jacobian of multivariable functions.
6. Applications to Maxima and Minima of two variables.
7. Solving the first and second order differential equations with initial/boundary conditions and visualising their solutions.
8. Solving the differential equations of electrical circuits – RC, LR and LCR.
9. Solving the system of linear equations using Gauss-Elimination and Gauss-Seidel Method.
10. Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Suggested software: Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA1BSMES	CO 1	Apply the concepts of Calculus and Matrix theory in solving problems.	1	3
	CO 2	Relate the importance of Calculus and Matrix theory concepts to Electrical engineering stream.	1	1
	CO 3	Demonstrate the understanding of Calculus and Matrix theory concepts through programming skills using modern tool - Python.	1,5,10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
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3. Matrices and System of Equations:https://www.classcentral.com/course/matrix-algebra-engineers-11986 and https://nptel.ac.in/courses/111106051
4. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&search_language=English&page=1

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU, Belagavi

DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FIRST SEMESTER B.E. (CS, IS, ML, BT, DS, IOT, CSB)

Course Title	Mathematical foundation for Computer Science stream -1	Course Code	22MA1BSMCS
Credits	4	L – T – P	2-1-1

Course Objectives: The objectives of the course are to facilitate the learners to

- **Appreciate** the importance of Calculus, Congruences and Matrix theory in computer and allied engineering science.
- **Gain the knowledge** of Calculus, Congruences and Matrix theory concepts to implement them in their core domain.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

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- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT - 1	**[08 hours]**

Calculus of One Variable:

Introduction to polar coordinates, polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations.

Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**

Multivariable Calculus

Partial differentiation, total derivative - differentiation of composite functions, Jacobian, Taylor's and Maclaurin's series expansion for two variables (statement only) – problems.

Applications: Maxima and minima for a function of two variables, Gradient descent method.

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

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 3	**[08 hours]**

Ordinary Differential Equations (ODEs) of First Order

Introduction to first order ordinary differential equations. Bernoulli's differential equations. Exact and reducible to exact differential equations- Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$.

Applications: Growth and decay, Orthogonal trajectories.

Self-Study: Nonlinear differential equations - Introduction to general and singular solutions, solvable for p, for x and y. Clairaut's equations.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 4	**[08 hours]**

Congruences and its applications

Introduction to Congruences, Linear Congruences, The Chinese Remainder theorem, Solving Polynomials, Linear Diophantine Equation, Euler's Theorem, Wilson Theorem and Fermat's little theorem.

Application: RSA algorithm.

Self-Study: Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 5	**[08 hours]**

Matrices and System of equations

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. Eigenvalues and eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.

Applications: Traffic flow.

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

(RBT Levels: L1, L2 and L3).

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
Autonomous Institute, Affiliated to VTU, Belagavi
DEPARTMENT OF MATHEMATICS

List of Lab Programs

Weekly: 1 Session (2 hours) **Batch Strength : 15 students**

Number of Labs: 12 (10 Sessions+2 Lab Assessments)

1. Introduction to Python: Installation of packages and Modules, Variables, Lists, Tuples, Strings and Dictionaries.
2. Control statements and Looping statements, Introduction to Numpy, Sympy and Matplotlib.
3. 2D plots for Cartesian and polar curves.
4. Finding angle between polar curves, curvature and radius of curvature of a given curve.
5. Finding partial derivatives and Jacobian of multivariable functions.
6. Applications to Maxima and Minima of two variables.
7. Solving the first order differential equations with initial conditions and visualising their solutions.
8. Finding GCD using Euclid's Algorithm and solving linear Congruence.
9. Solving the system of linear equations using Gauss-Elimination and Gauss-Seidel Method.
10. Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA1BSMCS	CO 1	Apply the concepts of Calculus, Congruences and Matrix theory in solving problems.	1	3
	CO 2	Relate the importance of Calculus, Congruences and Matrix theory in computer science stream.	1	1
	CO 3	Demonstrate the understanding of Calculus, Congruences and Matrix theory through programming skills using modern tool - Python.	1,5,10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
CIE – Theory	Quiz/AAT	10	90	50	25	10	50
	Test 1	40					
	Test 2	40					
	Test 3	40					
CIE – Lab	Record & Performance	100	120	10	25	10	
	Lab Test	15		15			
CIE				50		**20**	
SEE	End Exam	100		50		35	50
Grand Total Marks						**40**	**100**

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 1, 3, 5 and two questions each from Unit 2 and Unit 4.

Suggested Learning Resources:

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.
3. **D. C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
4. **T. Koshy:** "Elementary number theory with applications", Elsevier Science, 2nd Ed., 2007.
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6. **J. Kiusalaas** : "Numerical Methods in Engineering with Python 3", Cambridge university press, 2013.

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3. **N. P. Bali and M. Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. R. Wylie, L. C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., Newyork, 6th Ed., 2017.
5. **C. B. Gupta, S. R. Sing S. R. and M. Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
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7. **J. Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
8. **G. Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
9. **W. Stallings:** "Cryptography and Network Security" Pearson Prentice Hall, 6th Ed., 2013.
10. **M Lutz,** "Programming Python", O'Reilly Media, 4th edition, 2010.
11. **C. Jackson,** "Learning to Program using Python", Packt Publishing, 2nd edition, 2018.

Web links and Video Lectures (e-Resources):

1. Calculus of one and multivariable: https://nptel.ac.in/courses/111104092
2. Differential Equations: https://www.classcentral.com/course/differential-equations-engineers-13258
3. Congruences and its applications: https://www.classcentral.com/course/youtube-math-455-number-theory-90833/classroomand https://nptel.ac.in/courses/111101137
4. Matrices and System of Equations: https://www.classcentral.com/course/matrix-algebra-engineers-11986 and https://nptel.ac.in/courses/111106051
5. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&search_language=English&page=1

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU, Belagavi

DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

SECOND SEMESTER B. E.

Course Title	Mathematical foundation for Civil Engineering – 2	Course Code	22MA2BSMCV
Credits	04	L – T – P	2-1-1

Course Objectives: The goal of the course is to

- **Appreciate** the importance of calculus and numerical methods in the field of civil engineering.
- **Gain the knowledge** of calculus and numerical methods in the field of civil engineering.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT - 1	**[08 hours]**

INTEGRAL CALCULUS

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates.

Applications: Area(polar curves), Volume by triple integral, Mass of a plane laminar region.

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

Self-Study: Moment of Inertia along a particular direction.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**
VECTOR CALCULUS **Vector Differentiation:** Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. **Vector Integration:** Line integrals, Green's theorem and Stokes' theorem. **Application:** Work done by a force. **Self-Study:** Velocity and acceleration of a moving particle. Gauss divergence theorem. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 3	**[08 hours]**
PARTIAL DIFFERENTIAL EQUATIONS Formation of partial differential equations (PDE) by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Solution of Lagrange's linear PDE. Solution of homogeneous PDE by separation of variables. **Applications:** Mathematical modelling in terms of one-dimensional heat equation and wave equation. **Self-Study:** Solution of one-dimensional heat equation and wave equation by the method of separation of variables. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 4	**[08 hours]**
NUMERICAL METHODS -1 Solution of algebraic and transcendental equations: Newton-Raphson methods. Finite differences, Newton's forward and backward interpolation. Lagrange's interpolation and Lagrange's inverse Interpolation. N**umerical integration:** Simpson's $(1/3)^{rd}$ rule, Simpson's $(3/8)^{th}$ rule and Weddle's rule. **Applications:** Estimating the velocity, acceleration. Area, volume. **Self-Study:** Bisection method, Newton's divided difference formula. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 5	**[08 hours]**
NUMERICAL METHODS -2 **Numerical Solution of Ordinary Differential Equations (ODE's):** Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula, **Applications:** Finding approximate solutions to ODE related to civil engineering fields. **Self-Study:** Adam-Bashforth method. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation

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DEPARTMENT OF MATHEMATICS

List of Lab Programs

Weekly: 1 Session (2 hours) **Batch strength : 15 students**

Number of Labs: 12 (10 Sessions+2 Lab Assessments)

1. Program to compute surface area, volume and centre of gravity.
2. Evaluation of improper integrals.
3. Finding gradient, divergent, curl and their geometrical interpretation.
4. Verification of Green's theorem.
5. Solution of one-dimensional heat equation and wave equation.
6. Solution of algebraic and transcendental equations by Bisection method and Newton- Raphson method.
7. Interpolation/Extrapolation using Newton's forward and backward interpolation.
8. Computation of area under the curve using Simpson's (1/3)rd rule, Simpson's (3/8)th rule and Weddle's rule.
9. Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method.
10. Solution of ODE of first order and first degree by Runge-Kutta 4th order and Milne's predictor-corrector method.

Suggested software: Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA2BSMCV	CO 1	Apply the concepts of calculus and numerical methods in solving problems.	1	3
	CO 2	Relate the importance of calculus and numerical methods to civil engineering.	1	1
	CO 3	Demonstrate the understanding of the concepts of Calculus and Numerical methods through programming skills using modern tool - Python.	1, 5, 10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
CIE – Theory	Quiz/AAT	10	90	50	25	10	50
	Test 1	40					
	Test 2	40					
	Test 3	40					
CIE – Lab	Record & Performance	100	120	10	25	10	
	Lab Test	15		15			
CIE				50		**20**	
SEE	End Exam	100		50		35	50
Grand Total Marks						**40**	**100**

Two best scores out of the three tests will be considered for CIE.
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 4, 5 and two questions each from Unit 1 and Unit 3.

Suggested Learning Resources:

Text Books

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2. Integral and Vector Calculus: https://onlinecourses.nptel.ac.in/noc22_ma03/preview
3. Vector Calculus: https://www.classcentral.com/course/mit-opencourseware-multivariable-calculus-fall-2007-40962/classroom and https://www.classcentral.com/course/vector-calculus-engineers-17387
4. Partial Differential Equations: https://ocw.mit.edu/courses/18-152-introduction-to-partial-differential-equations-fall-2011/, https://archive.nptel.ac.in/courses/111/101/111101153/ and https://nptel.ac.in/courses/111103021 and https://www.classcentral.com/course/swayam-partial-differential-equations-17721
5. Numerical Methods: https://www.classcentral.com/course/numerical-methods-engineers-32822, https://nptel.ac.in/courses/111107105 and https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/
6. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&searchlanguage=English&page=1

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

SECOND SEMESTER B. E. (ME, IEM, AS, CH)

Course Title	Mathematical foundation for Mechanical Engineering stream- 2	Course Code	22MA2BSMME
Credits	04	L – T – P	2-1-1

Course Objectives: The goal of the course

- **Appreciate** the importance of calculus and numerical methods essential for Mechanical engineering.
- **Gain the knowledge** of calculus and numerical methods to implement them in their core domain.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT – 1	**[08 hours]**

INTEGRAL CALCULUS

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates.

Applications: Area (polar curves), Volume by triple integral, Mass of a plane laminar region.

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

Self-Study: Moment of Inertia along a particular direction.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**
VECTOR CALCULUS **Vector Differentiation:** Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. **Vector Integration:** Line integrals, Green's theorem and Stokes' theorem. **Application:** Work done by a force. **Self-Study:** Volume integral and Gauss divergence theorem. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 3	**[08 hours]**
PARTIAL DIFFERENTIAL EQUATIONS Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Solution of Lagrange's linear PDE. Solution of homogeneous PDE by separation of variables. **Applications:** Mathematical modelling in terms of one-dimensional heat equation and wave equation. **Self-Study:** Solution of one-dimensional heat equation and wave equation by the method of separation of variables. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 4	**[08 hours]**
NUMERICAL METHODS -1 Solution of algebraic and transcendental equations: Newton-Raphson methods. Finite differences, Newton's forward and backward interpolation. Lagrange's interpolation and Lagrange's inverse Interpolation. N**umerical integration:** Simpson's $(1/3)^{rd}$ rule, Simpson's $(3/8)^{th}$ rule and Weddle's rule. **Applications:** Estimating the velocity, acceleration. Area, volume. **Self-Study:** Bisection method, Newton's divided difference formula. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 5	**[08 hours]**
NUMERICAL METHODS -2: **Numerical Solution of Ordinary Differential Equations (ODE's):** Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula, **Applications:** Finding approximate solutions to ODE related to engineering fields. **Self-Study:** Adam-Bashforth method. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation

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9. Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method.
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Suggested software: Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	Course Outcome (CO)	PO	Strength
22MA2BSMME	CO 1	Apply the concepts of calculus and numerical methods in solving problems.	1	3
	CO 2	Relate the importance of calculus and numerical methods to Mechanical engineering stream.	1	1
	CO 3	Demonstrate the understanding of the concepts of Calculus and Numerical methods through programming skills using modern tool - Python.	1,5,10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
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CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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4. Partial Differential Equations: https://ocw.mit.edu/courses/18-152-introduction-to-partial-

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

SECOND SEMESTER B. E. (EEE, ETE, ECE, MD, EIE)

Course Title	Mathematical foundation for Electrical stream – 2	Course Code	22MA2BSMES
Credits	4	L – T – P	2-1-1

Course Objectives:

The objectives of the course are to facilitate the learners to

- **Appreciate** the importance of Calculus, Linear Algebra and Numerical methods in Electrical stream.
- **Gain the knowledge** of Calculus, Linear Algebra and Numerical methods in Electrical and allied engineering sciences.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
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- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT - 1	**[08 hours]**

INTEGRAL CALCULUS

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates.

Applications: Area (polar curves), Volume by triple integral.

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

Self-Study: Duplication formula. Moment of Inertia along a particular direction.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**
VECTOR CALCULUS **Vector Differentiation:** Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. **Vector Integration:** Line integrals, Green's theorem and Stokes' theorem. **Application:** Work done by a force. **Self-Study:** Volume integral and Gauss divergence theorem. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 3	**[08 hours]**
VECTOR SPACE AND LINEAR TRANSFORMATIONS **Vector spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. **Linear transformations**: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Rank and nullity of a linear operator, rank-nullity theorem. **Applications:** Geometric linear transformation in ¡ ^{2} for image processing. **Self-study:** Eigen spaces of a linear transformation. Invertible linear operators. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 4	**[08 hours]**
NUMERICAL METHODS -1 Solution of algebraic and transcendental equations: Newton-Raphson method. Finite differences, Newton's forward and backward interpolation. Lagrange's interpolation and Lagrange's inverse Interpolation. N**umerical integration:** Simpson's (1/3)rd rule, Simpson's (3/8)th rule and Weddle's rule. **Applications:** Estimating the velocity, acceleration. Area, volume. **Self-Study:** Bisection method, Newton's divided difference formula. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 5	**[08 hours]**
Numerical methods - 2 **Numerical Solution of Ordinary Differential Equations (ODE's)** Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula, **Applications:** Finding approximate solutions to ODE related to Electrical Engineering fields. **Self-Study:** Adam-Bashforth method. **(RBT Levels: L1, L2 and L3).**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
Autonomous Institute, Affiliated to VTU, Belagavi
DEPARTMENT OF MATHEMATICS

List of Lab Programs

Weekly: 1 Session (2 hours) **Batch strength :15 students**

Number of Labs: 12 (10 Sessions+2 Lab Assessments)

1. Program to compute area, surface area, volume and centre of gravity.
2. Evaluation of improper integrals.
3. Finding gradient, divergent, curl and their geometrical interpretation.
4. Computation of basis and dimension for a vector space and Graphical representation of linear transformation.
5. Verification of rank – nullity theorem.
6. Solution of algebraic and transcendental equation by Newton-Raphson method.
7. Interpolation/Extrapolation using Newton's forward and backward difference formula.
8. Computation of area under the curve using Trapezoidal, Simpson's (1/3)rd and (3/8)th rule
9. Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10. Solution of ODE of first order and first degree by Runge-Kutta 4th order and Milne's predictor-corrector method.

Suggested software: Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA2BSMES	CO 1	Apply the concepts of Calculus, Linear Algebra and Numerical methods in solving problems.	1	3
	CO 2	Relate the importance of Calculus, Linear Algebra and Numerical methods in Electrical stream.	1	1
	CO 3	Demonstrate the understanding of Calculus, Linear Algebra and Numerical methods through programming skills using modern tool - Python.	1, 5, 10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
CIE – Theory	Quiz/AAT	10	90	50	25	10	50
	Test 1	40					
	Test 2	40					
	Test 3	40					
CIE – Lab	Record & Performance	100	120	10	25	10	
	Lab Test	15		15			
CIE				50		**20**	
SEE	End Exam	100		50		35	50
Grand Total Marks						**40**	**100**

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 4, 5 and two questions each from Unit 1 and Unit 3.

Suggested Learning Resources:

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.
3. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
4. **C.R. Severance**: "Python for Everybody: Exploring Data Using Python 3", 1st edition, University of Michigan, 2016.
5. **J. Kiusalaas** : "Numerical Methods in Engineering with Python 3", Cambridge university press, 2013.

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., Newyork, 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. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
9. **J. Kiusalaas:** "Numerical methods in Engineering with Python 3", Cambridge University Press, 3rd Ed., 2013.
10. **M Lutz,** "Programming Python", O'Reilly Media, 4th edition, 2010.
11. **C. Jackson,** "Learning to Program using Python", Packt Publishing, 2nd edition, 2018.

Web links and Video Lectures (e-Resources):

1. Integral Calculus: https://www.classcentral.com/course/youtube-integral-calculus-90616 and https://www.edx.org/course/mathtrackx-integral-calculus
2. Integral and Vector Calculus: https://onlinecourses.nptel.ac.in/noc22_ma03/preview
3. Vector Calculus: https://www.classcentral.com/course/mit-opencourseware-multivariable-calculus-fall-2007-40962/classroom and https://www.classcentral.com/course/vector-calculus-engineers-17387
4. Partial Differential Equations: https://ocw.mit.edu/courses/18-152-introduction-to-partial-

differential-equations-fall-2011/, https://archive.nptel.ac.in/courses/111/101/111101153/ and https://nptel.ac.in/courses/111103021 and https://www.classcentral.com/course/swayam-partial-differential-equations-17721

5. Numerical Methods: https://www.classcentral.com/course/numerical-methods-engineers-32822, https://nptel.ac.in/courses/111107105 and https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/
6. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&searchlanguage=English&page=1

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

SECOND SEMESTER B.E. (CS, IS, ML, BT, DS, IOT, CSB)

Course Title	Mathematical foundation for Computer Science Stream-2	Course Code	22MA2BSMCS
Credits	4	L – T – P	2-1-1

Course Objectives: The objectives of the course are to facilitate the learners to

- **Appreciate** the importance of Calculus, Linear Algebra and Numerical methods in computer and allied engineering science.
- **Gain the knowledge** of concepts of Calculus, Linear Algebra and Numerical techniques to implement them in their core domain.
- Improve their **mathematical thinking** and **acquire skills** required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT -1	**[08 hours]**

INTEGRAL CALCULUS

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates.

Applications: Area(polar curves), Volume by triple integral.

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

Self-Study: Duplication formula. Moment of Inertia along a particular direction.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT - 2	**[08 hours]**
VECTOR CALCULUS Scalar and vector fields. Gradient, curl and divergence – physical interpretation, solenoidal and irrotational vector fields. **Orthogonal Curvilinear coordinates:** Scale factors, base vectors, transformation between cartesian and curvilinear systems, Cylindrical polar coordinates, Spherical polar coordinates. **Applications:** Directional derivative, Scalar potential. **Self-Study:** Area element, volume element in orthogonal curvilinear coordinates. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 3	**[08 hours]**
VECTOR SPACE AND LINEAR TRANSFORMATIONS **Vector spaces:** Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. **Linear transformations**: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Rank and nullity of a linear operator, rank-nullity theorem. **Applications:** Geometric linear transformation in ¡ ^{2} for image processing. **Self-study:** Eigenspaces of a linear transformation. Invertible linear operators. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 4	**[08 hours]**
NUMERICAL METHODS -1 Solution of algebraic and transcendental equations: Newton-Raphson methods. Finite differences, Newton's forward and backward interpolation. Lagrange's interpolation and Lagrange's inverse Interpolation. N**umerical integration:** Simpson's $(1/3)^{rd}$ rule, Simpson's $(3/8)^{th}$ rule and Weddle's rule. **Applications:** Estimating the velocity, acceleration. Area, volume. **Self-Study:** Bisection method, Newton's divided difference formula. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
UNIT - 5	**[08 hours]**
NUMERICAL METHODS -2 **Numerical Solution of Ordinary Differential Equations (ODE's):** Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula, **Applications:** Finding approximate solutions to ODE related to engineering fields. **Self-Study:** Adam-Bashforth method. **(RBT Levels: L1, L2 and L3).**	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF MATHEMATICS

List of Lab Programs

Weekly: 1 Session (2 hours) **Batch strength :15 students**

Number of Labs: 12 (10 Sessions+2 Lab Assessments)

1. Program to compute area, surface area, volume and centre of gravity.
2. Evaluation of improper integrals.
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10. Solution of ODE of first order and first degree by Runge-Kutta 4th order and Milne's predictor-corrector method.

Suggested software: Python

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA2BSMCS	CO 1	Apply the concepts of Calculus, Linear Algebra and numerical methods in solving problems.	1	3
	CO 2	Relate the importance of Calculus, Linear Algebra and numerical methods in computer science stream.	1	1
	CO 3	Demonstrate the understanding of Calculus, Linear Algebra and numerical methods through programming skills using modern tool - Python.	1, 5, 10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	Reduced Marks	Total	Min. Marks required for eligibility	Total Marks
CIE – Theory	Quiz/AAT	10	90	50	25	10	50
	Test 1	40					
	Test 2	40					
	Test 3	40					
CIE – Lab	Record & Performance	100	120	10	25	10	
	Lab Test	15		15			
CIE				50		**20**	
SEE	End Exam	100		50		35	50
Grand Total Marks						**40**	**100**

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 4, 5 and two questions each from Unit 1 and Unit 3.

Suggested Learning Resources:

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.
3. **D. C. Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
4. **C.R. Severance**: "Python for Everybody: Exploring Data Using Python 3", 1st edition, University of Michigan, 2016.
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Reference Books

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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.
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2. Integral and Vector Calculus: https://onlinecourses.nptel.ac.in/noc22_ma03/preview
3. Vector Calculus: https://www.classcentral.com/course/mit-opencourseware-multivariable-calculus-fall-2007-40962/classroomand https://www.classcentral.com/course/vector-calculus-engineers-17387
4. Vector spaces and Linear Transformations: https://nptel.ac.in/courses/111104137, https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/ and https://www.classcentral.com/subject/linear-algebra
5. Numerical Methods: https://www.classcentral.com/course/numerical-methods-engineers-32822, https://nptel.ac.in/courses/111107105 and https://ocw.mit.edu/courses/18-335j-introduction-to numerical-methods-spring-2019/
6. Python:https://spokentutorial.org/tutorialsearch/?search_foss=Python%203.4.3&search_language=English&page=1

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022-2023)

THIRD SEMESTER B. E.

(COMMON TO ALL BRANCHES EXCEPT CS, IS AND AI & ML)

Course Title	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES	**Course Code**	**22MA3BSTFN**
Credits	**03**	**L – T – P**	**2-1-0**
Contact Hours	**40**		

COURSE OBJECTIVES: The purpose of the course is to facilitate the learners to:

- Appreciate the importance of Series, Transforms and Numerical Techniques in Engineering Problems.
- Acquire the knowledge of Series, Transforms and Numerical Techniques to apply them in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Encourage the students for group learning to improve their creative and analytical skills.

UNIT-1

LAPLACE TRANSFORMS: **[08 hours]**

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of derivatives and integrals. Laplace Transform of periodic functions (statement only) and unit-step function – Problems. Inverse Laplace transforms: definition and problems. solution of differential equations.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-2

FOURIER SERIES: **[08 hours]**

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's conditions. Fourier series of periodic functions with period 2π and arbitrary period. Complex Fourier series. Practical harmonic analysis.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-3

FOURIER TRANSFORMS: **[08 hours]**

Definition and problems on Fourier Transform. Fourier sine and cosine transforms – Problems. Inverse Fourier transform, Inverse Fourier cosine and sine transforms - Problems. Convolution theorem (only statement) – problems.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-4

NUMERICAL SOLUTION OF PDE: **[08 hours]**

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt explicit formula and Crank-Nicholson method. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-5

CALCULUS OF VARIATIONS: **[08 hours]**

Definition, Variation of a functional, Euler's equation, variational problems.
Applications: Hanging cable problem, Brachistochrone problem.

Z-TRANSFORMS:

Definition, Standard Z-transforms, Damping rule, Shifting rule, Initial value and final value theorems-problems. Inverse Z-transform and applications to solve difference equations.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA3BSTFN	CO 1	Apply the concepts of Transform Techniques, optimization and Finite Difference Methods to solve engineering problems.	1	3
	CO 2	Analyze Engineering Application Problems using the concepts of Transform Techniques, optimization and Finite Difference Methods.	1	1
	CO 3	Demonstrate the importance of Transform Techniques, optimization and Finite Difference Methods in engineering using programing tools.	1 & 5	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 3 & 4 and two questions each from Unit 1 and Unit 5.

SUGGESTED LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCE BOOKS:

1. B.V. Ramana: "Higher Engineering Mathematics", McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics "Oxford University Press, 3rd Reprint, 2016.
3. N. P Bali and Manish Goyal: "A textbook of Engineering Mathematics", Laxmi Publications.
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics", McGraw–Hill Book Co. New York, 6th Edition.
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 (2014).
7. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://www.class-central.com/subject/math(MOOCs)
2. http://academicearth.org/
3. http://www.bookstreet.in.
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

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Autonomous Institute, Affiliated to VTU, Belagavi

DEPARTMENT OF MATHEMATICS

SYLLABUS (2022-2023)

THIRD SEMESTER B.E. COURSE (CSE and ISE)

Course Title	**STATISTICS AND DISCRETE MATHEMATICS**	**Course Code**	**22MA3BSSDM**
Credits	**03**	**L – T– P**	**2 – 1– 0**
Contact hours	**40**		

Prerequisites: Basic concepts of Permutations, Combinations, probability, statistics, G.C.D., L.C.D., divisors and primes.

Course Objectives: The goal of the course is to

- Appreciate the importance of Discrete Mathematics and statistics in computer and allied engineering science.
- Acquire the knowledge of Discrete Mathematics and Statistics applied in their core domain.
- Improve their Mathematical Thinking and acquire skills required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT-1

GRAPH THEORY **[08 hours]**

Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, sub-graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, minimal spanning tree: Kruskal's algorithm and shortest path-Dijkstra's algorithm.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-2

COMBINATORICS: **[08 hours]**

Introduction, Binomial and multinomial theorems, Catalan numbers, the principle of inclusion and exclusion, Derangements, Rook Polynomials, Generating functions.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-3

CURVE FITTING AND PROBABILITY **[08 hours]**

Curve fitting – Principle of least squares: fitting of straight line, parabola and exponential curve ($y = ab^x$). Correlation and Regression.

Theoretical distributions: Poisson distribution, Exponential and Normal distributions.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-4

STATISTICAL INFERENCE **[08 hours]**

Introduction, procedure for testing of hypothesis, level of significance.

[Large sample] Test of significance for single mean and difference between two means.

[Small sample] Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F-distribution) and Chi-Square goodness of fit.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-5

CONGRUENCES AND ITS APPLICATIONS: **[08 hours]**

Introduction to Congruences, Linear Congruences, The Chinese Remainder Theorem and solving polynomials. Euler's Theorem, Wilson's Theorem and Fermat's little Theorem (Statement Only) - Problems.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

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Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA3BSSDM	CO 1	Apply the concept of Discrete Mathematics and Statistics in Computer and allied engineering science.	1	3
	CO 2	Demonstrate the Importance of Discrete Mathematics and Statistics using Modern Tools.	5	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 3 & 5 and two questions each from Unit 1 and Unit 4.

Text Books:

1. Graph Theory and Combinatorics, D. S. Chandrasekharaiah, 4th edition, 2011-12, Prism Engineering Education Series.
2. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.
3. Discrete Mathematics and its applications, Kenneth H. Rosen, 7th edition, McGraw Hill Publishers.
4. Kenneth H. Rosen, Elementary number theory and its applications, 5th edition, Pearson publications.

Reference Books:

1. Discrete Mathematics, Kolman, BusbyRoss,5th edition, 2004, Prentice Hall.
2. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Eastern Economy Edition, PHI Learning Pvt., Ltd.
3. Mathematics for Machine Learning, Marc Peter Deisennorth, A. Aldo Faisal, Cheng Soon Ong,2020, Cambridge University Press.

E-books and online course materials:

1. http://jlmartin.faculty.ku.edu/~jlmartin/courses/math725-S16/
2. https://www.whitman.edu/mathematics/cgt_online/cgt.pdf

Online Courses and Video Lectures:

1. https://www.coursera.org/learn/probability-intro
2. https://nptel.ac.in/courses/111104026/(DiscreteMathematics)
3. https://nptel.ac.in/courses/111106086/(Combinatorics)

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B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022-2023)

THIRD SEMESTER B.E. COURSE (AI&ML)

Course Title	**Mathematical Foundations for Machine Learning**	**Course Code**	**22MA3BSMML**
Credits	**03**	**L – T– P**	**2 – 1– 0**
Contact Hours	**40**		

Prerequisites: Basic concepts of Permutations, Combinations, Mathematical Induction, G.C.D., L.C.D., divisors and primes.

Course Objectives:

The objectives of the course are to facilitate the learners to

- Appreciate the importance of Discrete Mathematical structures in Machine learning applications.
- Gain the knowledge of Discrete Mathematical tools and concepts to implement them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT-1

CONGRUENCES AND ITS APPLICATIONS: **[08 hours]**

Introduction to Congruences, Linear Congruences, Applications of The Chinese Remainder Theorem (without proof), Solving Polynomials, Euler's Theorem, Wilson's Theorem and Fermat's little Theorem (Only statements)-Problems, Applications of Congruences – RSA algorithm.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-2

GRAPH THEORY-1: **[08hours]**

Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, subgraphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-3

GRAPH THEORY-2: **[08hours]**

Trees, spanning and minimal spanning tree, Kruskal's algorithm, Prim's algorithm, Network flows, Shortest path Algorithm - Dijkstra's algorithm.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-4

COMBINATORICS: **[08hours]**

Introduction, Binomial and multinomial theorems, Catalan numbers, the principle of inclusion and exclusion, Derangements, Rook Polynomials.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-5

INDUCTION AND RECURRENCE RELATIONS: **[08hours]**

Mathematical Induction, Strong Induction, Recursive Definitions and Structural Induction, First order recurrence relations, second-order homogeneous recurrence relations, Generating functions.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

On completion of the course, student will have the ability to:

Course Code	CO#	COURSE OUTCOME(CO)	PO	Strength
22MA3BSMML	CO1	Apply Discrete mathematical tools and concepts in Machine learning algorithms	1	3
	CO2	Analyze the machine learning application using Discrete mathematical tools.	1	2
	CO3	Demonstrate the applications of machine learning concepts using the Discrete mathematical tools.	1, 5, 9, 10	2

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question in Units 1, 3, 4 and two questions each in unit 2 and unit 5.

Text Books:

1. Kenneth H. Rosen, Discrete Mathematics and its applications, 7th edition, McGraw Hill Publishers.
2. Discrete Mathematics, Kolman, Busby Ross, 5th edition, 2004, Prentice Hall

Reference Books:

1. Kenneth H. Rosen, Elementary number theory and its applications, 5th edition, Pearson publications.
2. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Eastern Economy Edition, PHIL earning Pvt., Ltd.
3. Graph Theory and Combinatorics, S. Chandrashekariah, 4th edition, Prism engineering education series.
4. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.

E books and online course materials:

1. http://jlmartin.faculty.ku.edu/~jlmartin/courses/math725-S16/
2. https://www.whitman.edu/mathematics/cgt_online/cgt.pdf

Online Courses and Video Lectures:

1. https://www.coursera.org/learn/probability-intro
2. https://nptel.ac.in/courses/111104026/(DiscreteMathematics)
3. https://nptel.ac.in/courses/111106086/(Combinatorics)

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SYLLABUS (2022-2023)
FOURTH SEMESTER B.E. COURSE (BT)

Course Title	**Biostatistics and Design of Experiments**	**Course Code**	**22MA4BSBDE**
Credits	**3**	**L – T – P**	**2-1-0**
Contact hours	**40**		

Pre-requisites:

- Basic concepts of Statistics
- Basic concepts of Probability- addition theorem, conditional probability, Bayes' theorem, discrete random variable - Binomial distribution.

Course Objectives:

- Student will get acquainted with the procedure of collecting, designing, analyzing and drawing inference about the data.
- To understand the fundamentals of design and the methods of optimization.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations.

UNIT-1

STATISTICS & PROBABILITY DISTRIBUTIONS **[08 hours]**

Curve fitting: $y = a + bx$, $y = a + bx + cx^2$, $y = ab^x$; Correlation and regression; Introduction to Probability; Discrete distribution - Poisson; Continuous distributions - Normal.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-2

STATISTICAL INFERENCE – I **[08 hours]**

Introduction - Sampling**,** Estimation – point, interval; Construction of confidence interval; Procedure for testing of hypothesis- level of significance. Test of significance for single proportion [Large sample], difference between two proportions [Large sample], ratio of variances (F- distribution), Chi -Square distribution-goodness of fit.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-3

STATISTICAL INFERENCE – II [COMPARISON OF MEANS] **[08 hours]**

Parametric test - Test of significance for single mean & difference of two means [Small & large sample], paired t- test, Analysis of variance (one-way).

Non-parametric test - Kruskal Wallis One Way Analysis of Variance by Ranks, Wilcoxon Signed Rank Test, Wilcoxon Mann-Whitney Test.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-4

DESCRIPTIVE STATISTICS: **[08 hours]**

Types of variables, measure of spread, logarithmic transformations, multivariate data. Basics of study design, cohort studies, model fitting.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-5

DESIGN AND ANALYSIS OF EXPERIMENTS **[08 hours]**

Principles of experimental design, Randomized block design, Completely Randomized block design, Latin Square Design, Factorial Experiments with case studies.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

On completion of the course, student will have the ability to:

CO#	Course Outcomes	PO	Strength
CO1	Analyze and interpret the statistical data for bioscience and allied engineering.	1,2	3
CO2	Design and demonstrate the use of Statistical tools to analyze the real-world examples of bioscience and allied engineering as a team.	5,9,10	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question from Units 2, 4,5 and two questions from Unit 1 and Unit 3

Text Books:

- Alvin E. Lewis, Biostatistics, McGraw-Hill Professional Publishing 2013.
- T. P. Chapman, Statistical Analysis of Gene Expression Microarray Data CRC 2003.
- John F. Monahan, Numerical Methods of Statistics (Cambridge Series in Statistical and Probabilistic Mathematics), Cambridge University Press, 2011.
- Warren J. Ewens, Gregory Grant, Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology and Health), Springer. 2010.
- P. S. S. Sundar Rao and J. Richard, An introduction to Biostatistics, 4th edition, 2006, Prentice Hall of India.

E books and online course materials:

1. VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
2. https://www.youtube.com/watch?v=1Q6_LRZwZrc
3. https://www.youtube.com/watch?v=gPt2DubVJQM
4. https://www.coursera.org/courses?query=biostatistics
5. https://www.edx.org/learn/biostatistics
6. https://www.classcentral.com/subject/biostatistics.

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FOURTH SEMESTER B. E.

(Common to AS/ME /EEE/ECE/ET/ML/CIVIL/EIE)

Course Title	COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS	**Course Code**	**22MA4BSCPS**
Credits	**03**	**L – T – P**	**2-1-0**
Contact Hours	**40**		

COURSE OBJECTIVES: The goal of the course is to:

- Appreciate the importance of Complex Analysis, Special Functions, Probability and Statistics in Engineering.
- Acquire the knowledge of Complex Analysis, Special Functions, Probability and Statistics applied in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Encourage the students for group learning to improve their creative and analytical skill.

UNIT-1

COMPLEX ANALYSIS: [08 hours]

Review of a function of a complex variable, limits, continuity and differentiability.

Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Construction of analytic functions by Milne-Thomson method, Problems.

Conformal mapping: $w = z^2$ and $w = z + \frac{k^2}{z}\ (z \neq 0)$.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-2

SPECIAL FUNCTIONS: [08 hours]

Introduction, Ordinary and Singular Points, Series solution of Bessel's differential equation leading to $J_n(x)$, Bessel's function of the first kind, Properties, generating function for $J_n(x)$. Series solution of Legendre's differential equation leading to $P_n(x)$, generating function for $P_n(x)$. Legendre polynomials, Rodrigue's formula (without proof) - Problems.

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-3

STATISTICAL METHODS: [08 hours]

Correlation and regression - Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis: lines of regression, angle between two regression lines - problems.

Curve Fitting: Fitting the straight line, parabola and geometric curve ($y = a\,x^b$) by the method of least squares.

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-4

PROBABILITY DISTRIBUTIONS: [08 hours]

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Poisson and normal distributions- problems (derivations for mean and standard deviation for Poisson distribution only)-Illustrative examples.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

UNIT-5

STATISTICAL INFERENCE: [08 hours]

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means (single mean and difference between two means), student's t-distribution (single mean and difference between two means), Chi-square distribution as a test of goodness of fit.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and Board, Problem based learning / Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA4BSCPS	CO 1	Apply the concepts of complex variables, special functions, probability and statistics to solve engineering problems.	1	3
	CO 2	Analyze the engineering data/problems using special functions, complex variables and statistical methods.	1	1
	CO 3	Demonstrate the importance of complex variables, special functions and statistical methods using programing tools.	5, 9, 10	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 3, 4 and two questions each from Unit 1 and Unit 5.

SUGGESTED LEARNING RESOURCES:

TEXT BOOKS:

1. Higher Engineering Mathematics, B. S. Grewal Khanna Publishers 44th Edition, 2017.
2. Advanced Engineering Mathematics, E. Kreyszig: John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995.
2. Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010.
3. A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014.
4. Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018.

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. http://www.bookstreet.in.
5. VTU EDUSAT PROGRAMME – 20
6. VTU e-Shikshana Program

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022-2023)

FOURTH SEMESTER B.E. COURSE

(CS/IS/AI&ML)

Course Title	**LINEAR ALGEBRA**	**Course Code**	**22MA4BSLIA**
Credits	**03**	**L – T – P**	**2-1-0**
Contact hours	**40**		

Course Objectives:

The objectives of the course are to facilitate the learners to

- Appreciate the importance of linear algebra in computer and allied engineering science.
- Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method(L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT-1

VECTOR SPACES **[8 hours]**

Introduction, Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.

Teaching-Learning Process:	Chalk and Board, Problem based learning

UNIT-2

LINEAR TRANSFORMATIONS **[8 hours]**

Introduction, Linear Mappings, Geometric linear transformation of ¡ ^{2}, Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof), Matrix representation of linear transformations, Singular and Non-singular linear transformations, Invertible linear transformations.

Teaching-Learning Process:	Chalk and Board, Problem based learning

UNIT-3

EIGENVALUES AND EIGENVECTORS **[8 hours]**

Introduction, Polynomials of Matrices, Applications of Cayley-Hamilton Theorem, eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.

Teaching-Learning Process:	Chalk and Board, Problem based learning

UNIT-4

INNER PRODUCT SPACES **[8 hours]**

Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error.

Teaching-Learning Process:	Chalk and Board, Problem based learning

UNIT-5

OPTIMIZATION TECHNIQUES IN LINEAR ALGEBRA **[8 hours]**

Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction – Principal component analysis.

Teaching-Learning Process:	Chalk and Board, Problem based learning

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Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
22MA4BSLIA	**CO 1**	Apply the concepts of linear algebra in Computer and allied Engineering Sciences.	1	3
	CO 2	Analyze the computer science and allied engineering Sciences applications using Linear algebra.	1	2

	CO 3	Demonstrate the applications of computer science and allied engineering Science applications using Linear algebra tools.	1, 5, 9, 10	1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.

CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 1, 4 and 5 and two questions each from Unit 2 and Unit 3.

SUGGESTED LEARNING RESOURCES:

Text Books:

1. Linear Algebra and its applications, David C. Lay, Steven R. Lay, Judi J Mc. Donald, 6th Edition, 2021, Pearson Education.
2. Linear Algebra and its applications, Gilbert Strang, 4th edition, 2005, Brooks Cole.
3. Linear Algebra: An Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition.

Reference Books:

1. Schaum's outline series -Theory and problems of linear algebra, Seymour Lipschutz, Marc Lipson, 6th edition, 2017, McGraw-Hill Education.
2. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.

E books and online course materials:

1. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
2. https://www.math.ucdavis.edu/~linear/linear.pdf

Online Courses and Video Lectures:

1. https://www.coursera.org/learn/linear-algebra-machine-learning
2. https://nptel.ac.in/syllabus/111106051/

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FOURTH SEMESTER B. E. COURSE - (CHEMICAL ENGINEERING)

Course Title	Statistics and Probability	Course Code	22MA4BSSAP
Credits	03	L – T – P	2 – 1 – 0
Contact hours	40 hours		

Prerequisites: Basic concepts of Statistics and Probability, addition theorem, conditional probability, Bayes' theorem, discrete random variable, Binomial distribution. Basic concepts of statistics. Matrices.

Course Objectives:

- To get acquainted with the procedure of collecting, designing, analyzing and drawing inference about the data
- To have insight into Statistical methods, Correlation and regression analysis.
- To develop probability distribution of discrete and continuous random variables, Joint probability distribution occurs in design engineering.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
- State the need for Mathematics with Engineering Studies and Provide real-life examples.
- Support and guide the students for self–study.
- You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
- Encourage the students for group learning to improve their creative and analytical skills.

UNIT-1

STATISTICS AND PROBABILITY **[08 hours]**

Curve fitting – Principle of least squares, fitting a straight line, fitting of a parabola, fitting of the exponential curve of the $y = ab^x$. Correlation and Regression

Probability distributions: Discrete distribution - Poisson distribution. Continuous distribution-Normal distribution.

Pedagogy:	Chalk and Board, Problem based learning.

UNIT-2

JOINT PROBABILTY AND MARKOV CHAIN **[08 hours]**

Joint Probability Distributions: Discrete random variables, Mathematical expectations, Covariance and Correlation.

Markov Chain: Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chain.

Pedagogy:	Chalk and Board, Problem based learning.

UNIT-3

STATISTICAL INFERENCE – I **[08 hours]**

Introduction, estimation – point, interval; procedure for testing of hypothesis, level of significance, construction of confidence interval.

[Large sample] Test of significance for single mean, difference between two means, single proportion,difference between two proportions, and difference of two Standard deviations.

Pedagogy:	Chalk and Board, Problem based learning.

UNIT-4

STATISTICAL INFERENCE – II **[08 hours]**

[Small sample] Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F- distribution), Chi -Square distribution-goodness of fit, independence of attributes. Analysis of variance (one-way and two-way classifications).

Pedagogy:	Chalk and Board, Problem based learning.

UNIT-5

DESIGN OF EXPERIMENTS **[08 hours]**

Principles of experimental design – Randomization, Replication, Local Control.
Randomized block design, Completely Randomized block design, Latin Square Design– Problems.

Pedagogy:	Chalk and Board, Problem based learning.

On Completion of the course, student will have the ability to:

CO #	COURSE OUTCOME (CO)	PO	Strength
CO 1	Apply the basic principles of statistics and probability, Markov chain and design of experiments to the problems in Engineering.	1	3
CO 2	Apply the concepts of Sampling distributions to Analyze and interpret the data from real world examples.	1	3
CO 3	Demonstrate an understanding of sampling distributions and principles of experimental design.	1,6,9,10	3,1,1,1

Assessment Details (both CIE and SEE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
	Test 3	40		20	
SEE	End Exam	100		50	

Two best scores out of the three tests will be considered for CIE.
CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question from Units 2, 3, 4 and two questions from Unit 1 and Unit 5.

Text Books:

1. Fundamentals of Biostatistics, Khirfan A. Khan, Atiya Khanum, 3rd edition, 2012, Ukaaz Publications.
2. An Introduction to Biostatistics, P. S. S. Sundar Rao and J. Richard, 4th edition, 2006, Prentice Hall of India.

Reference Books:

1. Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th edition, Wiley.
2. Biostatistics, P. N. Arora, P. K. Malhan, 2nd edition, 2013, Himalaya Publishing House

E-books and online course materials:

1. https://www.coursera.org/learn/basic-statistics
2. https://www.coursera.org/learn/probability-intro
3. https://www.classcentral.com/course/udacity-intro-to-statistics-361
4. http://wiki.stat.ucla.edu/socr/index.php/Probability_and_statistics_EBook

Online Courses and Video Lectures:

1. http://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring- 2014/
2. http://nptel.ac.in/courses/*111105041/1* NPTEL >> Mathematics >> Probability and Statistics
3. https:// www.khanacademy.org/Math
4. https:// www.class-central.com/subject/math (MOOCS).

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

THIRD SEMESTER B.E. (FOR LATERAL ENTRY STUDENTS)

Course Title	**Additional Mathematics - I**	**Course Code**	**22MA3BSMAT**
Credits	**0**	**L – T – P**	**2 – 1 – 0**
Contact Hours	**40**		

Course Objectives: The objective of the course is

- To facilitate the students with a foundation of differential calculus & analytical methods for solving engineering problems.

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.

UNIT -1

DIFFERENTIAL AND INTEGRAL CALCULUS: [8 Hours]

List of standard derivatives including hyperbolic functions, rules of differentiation. Polar curves, angle between the radius vector and the tangent, angle between two curves (No proof). Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems.

List of standard integrals, integration by parts. Definite integrals-problems.

(6L+2T)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT -2

MULTIVARIATE CALCULUS [08 hours]

Partial differentiation, total derivative-differentiation of composite functions. Jacobian and problems. Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

(6L+2T)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT -3

ORDINARY DIFFERENTIAL EQUATIONS (ODE's) OF FIRST ORDER [08 hours]

Bernoulli's differential equations. Exact and reducible to exact differential equations. Applications of ODE's - Orthogonal trajectories.

Nonlinear differential equations: Introduction to general and singular solutions; Solvable for p only.

(6L+2T)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

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UNIT -4

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER **[08 hours]**

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

(6L+2T)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT -5

PARTIAL DIFFERENTIAL EQUATIONS (PDE's) **[08 hours]**

Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Solution of PDE by the method of separation of variables. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation.

(6L+2T)

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO
22MA3IMMAT	CO 1	Demonstrate the concepts of differential calculus and Integral Calculus.	1
	CO 2	Apply the concepts of differential calculus to solve ordinary and partial differential equations	1

Assessment Details (CIE)

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz 1	10	100	05	50
	Quiz 2	10		05	
	Test 1	40		20	
	Test 2	40		20	

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Text Books

1. **B. S. Grewal:** "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018.
2. **E. Kreyszig:** "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference Books

1. **B.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C. Bhunia:** "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. **N. P. Bali and Manish Goyal:** "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co. Newyork, Latest ed.
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 (2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):

1. http://.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

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DEPARTMENT OF MATHEMATICS

SYLLABUS (2022 - 2023)

FOURTH SEMESTER B.E. (FOR LATERAL ENTRY STUDENTS)

Course Title	Additional Mathematics - II	Course Code	22MA4BSMAT
Credits	0	L – T – P	2 – 1 – 0

Course Objectives: The objective of the course is

- To facilitate the students with a foundation of integral calculus.
- To facilitate the students with a foundation of vector calculus, linear algebra and numerical techniques

Teaching-Learning Process (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples

UNT-1

NUMERICAL METHODS – 1 **[08 hours]**

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations; Gauss-elimination method and Approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-2

NUMERICAL METHODS -2 **[08 hours]**

Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.

Finite differences, Interpolation using Newton's forward and backward difference formulae and Lagrange's interpolation formula (without proof). Problems.

Numerical integration: Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules(without proof): Problems.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-3

NUMERICAL METHODS -3 **[08 hours]**

Numerical Solution of Ordinary Differential Equations (ODE's):

Numerical solution of ordinary differential equations of first order and first degree: Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth-order, Milne's predictor-corrector formula (No derivations of formulae). Problems.

Teaching-Learning Process	Chalk and talk method / Power Point Presentation

UNIT-4

INTEGRAL CALCULUS **[08 hours]**

Multiple Integrals: Evaluation of double integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Evaluation of triple integrals. Problems.

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

UNIT-5

BETA-GAMMA FUNCTIONS AND VECTOR INTEGRATION **[8 Hours]**

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

Vector Integration: Line integral, Green's theorem and Stokes' theorem

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcomes (Course Skills Set)

After successfully completing the course, the student will be able to understand the topics:

COURSE CODE	CO	COURSE OUTCOME (CO)	PO
22MA4IMMAT	CO 1	Apply the concepts of linear algebra and numerical methods	1
	CO 2	Apply the concepts of integral calculus	1

Assessment Details:

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz 1	10	100	05	50
	Quiz 2	10		05	
	Test 1	40		20	
	Test 2	40		20	

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Suggested Learning Resources:

Text Books

1. **B. S. Grewal:** "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018.
2. **E. Kreyszig:** "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference Books

1. **B.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C. Bhunia:** "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.

3. **N.P Bali and Manish Goyal:** "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co. New York, Latest ed.
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 (2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

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SIXTH SEMESTER – INSTITUTIONAL ELECTIVE

Course Title	**NUMERICAL METHODS FOR ENGINEERS**	**Course Code**	**20MA6IENME**
Credits	**03**	**L – T – P**	**3 – 0 – 0**
Contact hours	**39 hours**		

Prerequisites: Matrix theory, Differential and Integral Calculus, Differential Equations.

Course Objectives: The purpose of the course is to encourage the students to apply numerical techniques. To enhance computational skills for solving mathematical equations. To train the students to solve the complex engineering problems in their respective domain.

UNIT-1

ITERATIVE METHODS FOR SYSTEM OF EQUATIONS AND EIGEN VALUES AND VECTORS: [07 hours]

Fixed point iteration methods, Thomas algorithm for tri-diagonal systems, Newton's method for solving nonlinear systems,
Power Method, Rayleigh Power method, Jacobi's Methods, Given's Method.

UNIT-2

INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION: [08 hours]
Linear interpolation, Piecewise polynomial interpolation: Cubic spline interpolation.
Stiriling's formula and Bessel's formula. Richardson extrapolation.
Boole's and Romberg integration. Evaluation of Double Integrals using Numerical Methods – Trapezoidal Rule - Simpson's Rule.

UNIT-3

METHODS FOR INITIAL VALUE PROBLEMS: [08 hours]
Predictor–Corrector methods- Milne's method –Adam's Bashforth method. Finite difference methods. Relaxation Methods; Solution of Eigen value problems (ODE). Solving system of ODE using Runge-Kutta 2^{nd} and 4^{th} order methods.

UNIT-4

METHODS FOR BOUNDARY VALUE PROBLEMS: [08 hours]
Introduction to boundary value problem (BVP): Solving BVP using Shooting method, Finite difference method, cubic spline method and successive over Relaxation (SOR) method.
Solution of integral equations using finite difference method.

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UNIT-5

METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS: [08 hours]

Solution of Elliptic PDEs, Poisson's equations, Finite difference method for 1D elliptic problem, Finite difference method for 2D elliptic problem, Finite difference for parabolic problems (generality), Lax-Wendorff method, ADI method and SOR Method.

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On completion of the course, student will have the ability to:

Course Code	CO #	COURSE OUTCOME (CO)	PO	Bloom's level
20MA6IENME	CO 1	Determine the solution of the non-linear system of equations	1, 2, 5	3
	CO 2	Compute the Eigen values and corresponding Eigen vectors using iterative methods	1, 2, 5	3
	CO 3	Apply numerical techniques to find differentiation and integration.	1, 2, 5	3
	CO 4	Interpret the solutions of ordinary differential equations	1, 2,3,5	3
	CO 5	Analyze the numerical solutions of partial differential equations	1, 2,3,5	3

Text Books:

3. MK Jain, SRK Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computations, 6th edition, 2007, New Age International Publishers.
4. S.S.Sastry, Introductory methods of numerical analysis, Fifth Edition, 2012, PHI Publishers

Reference Books:

1. Steven V. Chapra, Applied Numerical Methods with Matlab for Engineers and Scientists, Third Edition, 2011, McGraw-Hill Edition.
2. Richard L. Burden, Douglas J. Faires, A.M.Burden, Numerical Analysis, 10th Edition, 2010, Cengage Publishers.
3. M.D. Raisinganiah, Integral Equations and Boundary Value Problems, S.Chand Publishers.

E books and online course materials:

1. https://www.classcentral.com/course/swayam-numerical-methods-for-engineers-14213

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc19_ge30/preview
2. https://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/

Question Paper Pattern:

1. Five full questions to be answered
2. To set SEE question paper, one question each in Units 1, 2, 5 and two questions each in Unit 3 and Unit 4.

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SEVENTH SEMESTER – INSTITUTIONAL ELECTIVE

Course Name	**Computational Graph Theory**	**Course Code**	**21MA7IECGT**
Credits	**03**	**L – T - P**	**3 - 0 - 0**
Contact hours	**39 hours**		

Course Objectives: The objective of the course is to introduce the concepts in graph Theory, with a sense of algorithms and some modern applications. They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

UNIT-1

GRAPHS AND DIGRAPHS **[8 hours]**

Fundamentals of graphs and digraphs, modelling using graphs and digraphs, graph search – BFS, DFS. The shortest path algorithms: Dijkstra algorithm, Bellman Ford algorithm. Minimum weight spanning tree: Kruskal's algorithm and Prim's algorithms. Applications: Job sequencing problems, designing an efficient computer drum, making a road system one-way.

UNIT-2

EULERIAN AND HAMILTONIAN GRAPHS **[7 hours]**

Transportation Problems: Eulerian graphs, Fleury's algorithm, Chinese Postman Problem, Hamiltonian cycles, Travelling Salesman Problem, applications.

UNIT-3

CONNECTIVITY **[8 hours]**

Vertex and edge connectivity, separable graphs, block graphs, k-connected graphs, maximum flow Problem, Ford-Fulkerson algorithm, Min Cut - Max Flow theorem, Maximum Flow of Minimum Cost, feasible flows. Construction of reliable communication networks-The minimum connector problem, enumeration of chemical molecules and electrical networks.

UNIT-4

COVERING AND MATCHING **[8 hours]**

Vertex and edge covering, vertex and edge independence, matchings, perfect matchings, maximum matching, Hall's theorem, augmenting path, Edmond's algorithm, maximal independent sets, König's Min-Max theorem, Gale-Shapley Algorithm, Minimum path cover**,** Friend's strangers problem.

UNIT-5

COLORABILITY **[8 hours]**

Vertex colouring, Chromatic Number, Bi-chromatic, Edge coloring and its applications to timetabling and sport scheduling, Vizing's theorem, Sequential coloring algorithm, map coloring, Four Color problem, chromatic polynomial. König's theorem, Applications: Scheduling examinations, Frequency assignments, Index registers.

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Text Books

1. Narsing Deo, Graph Theory, PHI, 2014.
2. Geir Agnarsson & Raymond Greenlaw Pearson, Graph Theory, modelling, applications and algorithms, Prentice Hall, 2007.

Reference Books

1. Frank Harary, Graph Theory, Addison Wesley, Reading, Massachussets, 1969.
2. Jonathan L. Gross, Jay Yellen, Graph Theory and its Applications, 2nd Edition, CRC Press LLC, Florida, 2000.
3. Gary Chartrand and Ping Zhang, Introduction to Graph Theory, McGraw Hill, 2005.

At the end of the course the students will be able to

CO	Course Outcomes	PO's
CO-1	Demonstrate an understanding of the fundamental concepts of graph theory, digraphs, trees, finding Paths and cycles, weighted graphs matching and graph coloring.	**1,2**
CO-2	Apply appropriate graph algorithms to solve problems involving transportation, connection, social networking and scheduling.	**1,2**
CO-3	Analyse the algorithms to find the shortest path, maximum flow of minimum cost, maximum matching and minimum path cover.	**2**
CO-4	Use of MATLAB to find the shortest path, minimum weighted spanning tree, maximum flow.	**5**

Question Paper Pattern

- Each unit consists of one full question.
- Five full question to be answered.
- Internal choice in Unit 1 and Unit 5.

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DEPARTMENT OF MATHEMATICS

SEVENTH SEMESTER – INSTITUTIONAL ELECTIVE

Course Title	**NUMBER THEORY**	**Course Code**	**21MA7IENMT**
Credits	**03**	**L – T – P**	**3 – 0 – 0**
Contact hours	**39 hours**		

Course Objectives: The course is a graduate level introduction Number Theory in which, it will cover fundamentals of the subject. It has contributed to many practical problems such as Coding Theory, Cryptography in modern information technology.

UNIT-1

CONGRUENCES: **[09 hours]**

Introduction, Congruences and Equivalence Relations, Linear Congruences, Linear Diophantine Equations and the Chinese Remainder Theorem, Modular Arithmetic: Fermat's Theorem, Wilson's Theorem and Fermat Numbers. Polynomial congruences, Pythagorean equations.

UNIT-2

ARITHMETIC FUNCTIONS: **[07 hours]**

Introduction, Sigma Function, Tau Function, Dirichlet Product, Dirichlet Inverse, Moebius Function, Euler's Function, Euler's Theorem, An application to Algebra.

UNIT-3

PRIMITIVE ROOTS AND INDICES: **[07 hours]**

The order of a positive integer, primality tests, primitive roots for primes, the algebra of indices.

UNIT-4

QUADRATIC CONGRUENCE AND CONTINUED FRACTION: **[09 hours]**

Legendre symbol, Quadratic reciprocity, the Jacobi symbol, finite continued fractions, infinite continued fractions.

UNIT-5

NON LINER DIOPHANTINE EQUATIONS: **[07 hours]**

Pythagorean triangles, Fermat's last theorem, Sum of Squares, Pell's equation, Mordell's equation.

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On completion of the course, student will have the ability to:

CO No	Course Outcomes	PO
1	Apply the concept of congruence to compute system of equations (algebraic equations)	1
2	Demonstrate an understanding towards the nature of different functions	1
3	Demonstrate an understanding primitive roots and indices	1
4	Apply concept of quadratic congruence to evaluate quadratic residues and understand continued fractions.	1
5	Demonstrate an understanding with some important non-linear Diophantine equation.	1

Text Books:

5. Elementary number theory with Applications-2nd Edition-Thomas Koshy 2009.
6. Beginning Number Theory by Neville Robbins-2nd Edition-Jones and Barlett Publ.-2006.

Reference Books:

4. Elementary Number Theory by David M Burton - Tata McGraw Hill Publ.-6th Edition 2006.
5. Elementary Number Theory by Gareth A. Jones and Josephine Mary Jones - Springer-1998.

Question Paper Pattern:

- Each unit consists of one full question.
- Each full question consists of two, three or four subdivisions.
- Five full question to be answered.
- Internal choice in Unit 1 and Unit 4.

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EIGHTH SEMESTER – INTITUTIONAL ELECTIVE - (Except CSE/ISE Branch)

Course Title	**Linear Algebra**	**Course Code**	**21MA8IELIA**
Credits	**03**	**L – T – P**	**3 – 0 – 0**
Contact hours	**36 hours**		

Prerequisites: Vector Algebra, Matrix theory, Calculus, Geometry, Group Theory.

Course Objectives: To provide the students with a foundation of concepts in linear algebra that is essential to engineers of computer and information science.

UNIT-1

VECTOR SPACES **[7 hours]**

Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.

UNIT-2

LINEAR TRANSFORMATIONS **[7 hours]**

Introduction, Linear Mappings, Geometric linear transformation of $\mathbb{R}^2$, Kernel and Image of a linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem(No proof), Singular and Nonsingular linear transformations, Invertible linear transformations.

UNIT-3

EIGENVALUES AND EIGENVECTORS **[8 hours]**

Introduction, polynomials of matrices, characteristic polynomial, Cayley-Hamilton theorem, eigenvalues and eigenvectors, eigen spaces of a linear transformation, diagonalization, minimal polynomial, characteristic and minimal polynomials of block matrices, Jordan canonical form.

UNIT-4

INNER PRODUCT SPACES **[7 hours]**

Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error.

UNIT-5

SYMMETRIC MATRICES AND QUADRATIC FORMS **[7 hours]**

Diagonalization of real symmetric matrices, Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Singular value decomposition.

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On completion of the course, student will have the ability to:

Course Code	CO #	Course Outcome (CO)	PO
21MA8IELIA	CO 1	Apply the concepts of Matrices to Vectors spaces.	1
	CO 2	Relate the concepts of Eigen values, Eigen vectors & functions to linear algebra.	
	CO 3	Apply the concepts of inner products.	

Text Books:

3. Linear Algebra and its applications, David C. lay, Steven R. lay, Judi J Mc. Donald, 5th Edition, 2015, Pearson Education.
4. Linear Algebra and its applications, Gilbert Strang, 4th edition, 2005, Brooks Cole.

Reference Books:

3. Schaum's outline series-Theory and problems of linear algebra, Seymour Lipschutz, 5th edition, 2012, McGraw-Hill Education.
4. Linear Algebra an Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition.

E books and online course materials:

3. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
4. https://www.math.ucdavis.edu/~linear/linear.pdf

Online Courses and Video Lectures:

3. https://www.coursera.org/learn/linear-algebra-machine-learning
4. https://nptel.ac.in/syllabus/111106051/

Question Paper Pattern:

3. Five full questions to be answered.
4. To set one question each in Units 1, 2, 5 and two questions each in Unit 3 and Unit 4.

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