

Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution, Aided by Govt. of Karnataka and Affiliated to Visvesvaraya Technological University, Belgaum)

Mallathahalli, Outer Ring Road, Bengaluru-560 056



BOARD OF STUDIES

OF

SCHOOL OF APPLIED SCIENCE & HUMANITIES

CURRICULUM & DETAILED SYLLABI

of

MATHEMATICS PROGRAMME

I to IV Semesters & Open electives B.E.

(FOR THE ACADEMIC YEAR 2026-2027)

Submitted to

DEAN ACADEMIC

For

Seeking Approval from Academic Council (AC)

Agenda of the meeting:

Sl. No.	Agenda
1.	Need for revision of previous syllabus if any.
2.	Declaration of equivalences for past courses.
3.	Modification of open Electives.
4.	Any other.

RESOLUTION

At the outset, HoP of Mathematics programme, Dr Shivaprasanna G S welcomed all the members to the meeting.

1. External members suggested that the contents in the existing syllabus are well structured and no further changes are required for the current academic year.
2. The first-year syllabi are approved with minor corrections in CO and PO Mappings.
3. All the external members have suggested to have the Mathematics course for all branches for the First and Second year B.E. Further, they have suggested to offer elective courses in Mathematics in the Third year also.
4. The syllabus for open electives and diploma courses were discussed and finalized.
5. It is noted that the SEE question papers contain less than 15% questions from Lab components. Hence, it is suggested to include more questions from lab components without option from AY 2026-27 onwards.

Dr. Ambedkar Institute of Technology
(An Autonomous Institution, Aided by Govt. of Karnataka and Affiliated to VTU, Belgaum)



School of Applied Science and Humanities, Mathematics Programme
Syllabus proposed for approval as per NEP Model Curriculum Guidelines

CURRICULUM AND SYLLABUS OF MATHEMATICS PROGRAMME

(For the First-year students admitted during the AY 2026-27 and Second year students Admitted on or before AY 2025-026)

For UG : BE Regular Students:

Course Code	Course Title	Teaching hours per week				Credit Assigned
		L	T	P	SS	
First Semester B.E. Programmes						
1BMAU101A	Differential Calculus and Linear Algebra (CV)	3	0	2	–	4
1BMAU101B	Calculus and Linear Algebra (CSE, ISE, CSBS, CSDS, AIML)	3	0	2	–	4
1BMAU101C	Differential Calculus and Linear Algebra (ME, IEM, AE)	3	0	2	–	4
1BMAU101D	Differential Calculus and Linear Algebra (EE, EC, ET, EI, VLSI)	3	0	2	–	4
Second Semester B.E. Programmes						
1BMAU201A	Differential Calculus and Numerical Methods (CV)	3	0	2	–	4
1BMAU201B	Numerical Methods (CSE, ISE, CSBS, CSDS, AIML)	3	0	2	–	4
1BMAU201C	Multivariable Calculus and Numerical Methods (ME, IEM, AE)	3	0	2	–	4
1BMAU201D	Calculus, Laplace Transforms and Numerical Techniques (EE, EC, ET, EI, VLSI)	3	0	2	–	4
Third Semester B.E. Programmes						
1BMAT301A	Probability and Statistics (CV, ME, IEM, AE)	3	2	0	–	4
1BMAT301B	Probability and Statistical Inference (CSE, ISE, CSBS, CSDS, AIML)	3	2	0	–	4
1BMAT301D	Transforms and Statistical Techniques (EE, EC, ET, EI, VLSI)	3	2	0	–	4
Fourth Semester B.E. Programmes						
1BMAT401B	Discrete Mathematical Structures (CSE, ISE, CSBS, CSDS, AIML)	3	2	0	–	4
1BMAT401D	Complex Analysis and Numerical Techniques (EC, ET, EI, VLSI)	3	2	0	–	4

Bridge Courses (For Lateral Entry Students): Common to All programs						
1BMATDIP31	Basic Engineering Mathematics–I	1	–	–	2	0*
1BMATDIP41	Basic Engineering Mathematics–II	1	–	–	2	0*
Open Electives						
1BMAE01	Numerical Methods for Engineering	3	2	0	–	4
1BMAE02	Mathematical Computing for Artificial Intelligence	3	2	0	–	4

*Non-credit course.

Nomenclatures:

- a) Civil Engineering Stream:** includes B.E.in Civil Engineering course.
- b) Computer Science Engineering Stream:** includes B.E.in the following streams
 - (i) Computer Science and Engineering (CSE).
 - (ii) Information Science and Engineering (ISE).
 - (iii) Computer Science & Business systems (CSBS).
 - (iv) Computer Science & Data Science (CSDS).
 - (v) Artificial Intelligence & Machine Learning (AIML).
- c) Mechanical Engineering Stream:** includes B.E.in the following streams
 - (i) Mechanical Engineering (ME).
 - (ii) Industrial Engineering and Management (IEM).
 - (iii) Aeronautical Engineering (AE).
- d) Electrical and Electronics Engineering Stream:** includes B.E.in the following streams
 - (i) Electrical and Electronics Engineering (EEE).
 - (ii) Electronics and Communication Engineering (ECE).
 - (iii) Electronics and Tele Communication Engineering (ETE).
 - (iv) Electronics and Instrumentation Engineering (EIE).
 - (v) Very Large-Scale Integration (VLSI).

Course Title	Differential Calculus and Linear Algebra (CV)						
Course Code	1BMAU101A						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills to employ basic tools of differential calculus for solving engineering problems.
CLO2	Introduce the concepts of linear algebra, matrix theory, systems of equations, eigenvalues, and eigenvectors.
CLO3	Apply polar coordinates, curvature, and multivariable calculus concepts to domain-related problems.
CLO4	Develop techniques to solve ordinary differential equations of first and higher orders.
CLO5	Utilize modern mathematical tools (e.g., wxMAXIMA) to solve engineering problems interactively.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Linear Algebra Elementary row transformation of a matrix, echelon form, rank of a matrix. Consistency, solution of system of linear equations – Gauss elimination method. Rayleigh's power method to find the dominant eigenvalue and eigenvector.		
SELF-STUDY COMPONENTS: Eigenvalues and eigenvector. Normal form and solution of system of linear equations by Gauss- Jordan method.		
UNIT 2	8	L1-L4
Polar Curves and Curvature Polar coordinates, polar curves, angle between the radius vector and the tangent, angle between two polar curves. Pedal equations. Curvature and Radius of curvature-cartesian and pedal forms (without proof).		
SELF-STUDY COMPONENTS: Radius of curvature-polar form, Tracing of curves (cartesian, parametric and polar).		
UNIT 3	8	L1-L4
Ordinary Differential Equations of First Order Exact and reducible to exact differential equations with integrating factors: $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ and $-\frac{1}{M}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ only. Orthogonal trajectories.		
SELF-STUDY COMPONENTS: Bernoulli's differential equation. Reducible to exact-IF by inspection.		
UNIT 4	9	L1-L4

Ordinary Differential Equations of Higher Order

Higher order linear differential equations with constant coefficients-homogeneous and non-homogeneous, inverse differential operator: e^{ax} , $\sin(ax+b)$ or $\cos(ax+b)$, x^n only. Cauchy's homogeneous differential equations.

SELF-STUDY COMPONENTS:

Method of variation of parameters. Legendre's non-homogeneous differential equations.

UNIT 5

9

L1-L4

Series Expansion and Multivariable Calculus

Statement and problems on Taylor's and Maclaurin's series expansion for one variable. Partial differentiation, Euler's theorem. Total derivative – differentiation of composite functions, Jacobian.

SELF-STUDY COMPONENTS:

Maxima and Minima for the function of two variable. Extended Euler's theorem.

Practical Component

Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.

1	Analyzing standard 2D curves in polar, parametric and Cartesian forms. Also determining the point of intersection, nature of tangent and angle between polar curves.
2	Evaluation of bending of curves and nature at a given point on it.
3	Determination of flow of a multivariable function along the given direction and also identify the independence of given multivariable functions.
4	Determination of the optimal values of unconstrained function of at most two variables.
5	Determination of the primitive of first order differential equations.
6	Solution of higher order ordinary differential equations.
7	Identifying the nature of given set of lines or planes using rank method.
8	Finding all the eigenvalues of a square matrix of order up to four using Rayleigh power method.
9	Solution of second order ordinary differential equations the method of variation of parameter.
10	Solution of simultaneous differential equations.

TEXT BOOKS:

1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44 th Ed., 2021.
2	E. Kreyszig, Advanced Engineering Mathematics, John Wiley and sons, 10 th Ed., 2018

REFERENCE BOOKS:

1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11 th Ed., 2017
2	Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 3 rd Ed., 2016.
3	N. P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, 10 th Ed., 2022.

e-LEARNING RESOURCES:

1	http://academicearth.org/
2	VTU e-Shikshana Program

Assessment Details both (CIE and SEE)					
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks. **Self-Study Component should be not included for SEE & CIE.					
CONTINUOUS INTERNAL EVALUATION (CIE)			Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3		30		12
Laboratory components	Rubrics for experiment are added, then taken average		10	20	08
	Lab CIE		10		
TOTAL			50		20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Learn the concept of matrix theory for solving the system of linear equations, eigenvalues and eigenvectors.
CO2	Understand the concept of polar curves, pedal equations curvature and radius of curvature.
CO3	Apply the concept of differential equations to study exact differential equations and orthogonal trajectories.
CO4	Analyze the higher order differential equations with constant coefficients in terms of homogeneity and non-homogeneity.
CO5	Develop the power series of a function of a single variable, study partial differentiation, Jacobian for multivariable functions and the modern mathematical tool – wxMAXIMA.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2												
CO2	2	3												
CO3	3	2												
CO4	2	3												
CO5	1	1	2		2									

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							
CO4	3	2							
CO5	2	2	2		2				

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3					2								
CO4				3					2								
CO5				3					2								

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: I

Scheme: 2025

Course Title	Calculus and Linear Algebra (CSE, ISE, CSBS, CSDS, AIML)						
Course Code	1BMAU101B						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills to employ basic tools of differential calculus for solving basic and complex engineering problems.
CLO2	Develop analytical skills for polar curves, pedal equations, curvature, and radius of curvature.
CLO3	Introduce concepts of linear algebra, matrix echelon form, system of linear equations, and matrix diagonalization with applications like traffic flow.
CLO4	Apply multivariable calculus and vector calculus concepts including gradient, divergence, curl, and curvilinear coordinates to domain problems.
CLO5	Understand vector spaces, linear independence, basis, dimension, and utilize modern mathematical tools (wxMAXIMA) for problem solving.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Linear Algebra Elementary row transformation of a matrix, Echelon form, rank of a matrix. Consistency and solution of system of linear equations: Gauss elimination method, Gauss-Jordan method. Applications: Traffic flow, diagonalization of the matrix. SELF-STUDY COMPONENTS: Eigenvalues and Eigenvectors. Normal form of the matrix.		
UNIT 2	8	L1-L4
Polar Curves and Curvature Polar coordinates, polar curves, angle between the radius vector and the tangent, angle between two polar curves. Pedal equations. Curvature and Radius of curvature- Cartesian and pedal forms (without proof). SELF-STUDY COMPONENTS: Radius of curvature-parametric and polar. Tracing of curves (cartesian, parametric and polar).		
UNIT 3	8	L1-L4
Multivariable Calculus Partial differentiation, Euler's theorem, total derivative, differentiation of composite functions, Jacobian. Statements of Taylor's and Maclaurin's series expansion for two variables. SELF-STUDY COMPONENTS: Maxima and minima for the function of two variables.		
UNIT 4	9	L1-L4
Vector Calculus Scalar and vector fields, gradient, directional derivatives, divergence and curl, solenoidal vector fields, irrotational vector fields and scalar potential. Curvilinear coordinates: Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, orthogonality.		

SELF-STUDY COMPONENTS: Vector Identities.		
UNIT 5	9	L1-L4
Vector Space Vector spaces- definition and examples, subspace- definition and examples. Linear Combinations, linear span, linearly independent and dependent sets, basis and dimension, row space and column space of a matrix and orthogonality.		
SELF-STUDY COMPONENTS: Coordinate vector, inner products. Rank-Nullity theorem.		

Practical Component	
Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.	
1	Analyzing standard 2D curves in polar, parametric and Cartesian forms. Also determining the point of intersection, nature of tangent and angle between polar curves.
2	Evaluation of bending of curves and nature at a given point on it.
3	Determination of flow of a multivariable function along the given direction and also identify the independence of given multivariable functions.
4	Determination of the optimal values of unconstrained function of at most two variables.
5	Identifying the nature of given set of lines or planes using rank method.
6	Solution of system of linear equations.
7	Finding all the eigenvalues of a square matrix of order up to four using Rayleigh power method.
8	Vector differential operator applied on scalar and vector point functions.
9	Application problems on vector differential operator.
10	Testing independence of vectors, computation of basis and dimension a vector space.

TEXT BOOKS:	
1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	Gilbert Strang, Linear Algebra and its Applications, Cengage Publications, 4th Ed., 2022.

REFERENCE BOOKS:	
1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	N. P Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
3	James Stewart, Calculus, Cengage Publications, 7th Ed., 2019.

e-LEARNING RESOURCES:	
1	http://academicearth.org/
2	VTU e-Shikshana Program & VTU EDUSAT Program

Assessment Details both (CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory Components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE.

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: I

Scheme: 2025

Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	30		12
Laboratory components	Rubrics for experiment are added, then taken average	10	20	08
	Lab CIE	10		
TOTAL		50		20

QUESTION PAPER PATTERN (SEE)

Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

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

CO1	Learn the concept of matrix theory for solving the system of linear equations, eigenvalues and eigenvectors.
CO2	Understand the concept of polar curves, pedal equations curvature and radius of curvature.
CO3	Apply the concept of partial differentiation, Jacobian and determine power series of a function of two variables
CO4	Analyze the concept of vector calculus to study the various vector operators and curvilinear coordinates.
CO5	Develop an understanding of vector spaces, subspaces and study its various properties and related mathematical concepts and the modern mathematical tool – wxMAXIMA.

Mapping of CO's, PO's with PSO's

Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2												
CO2	2	3												
CO3	2	2												
CO4	2	3												
CO5	1	1	2		2									

Mapping of CO's with Knowledge and Attitude Profile (WK)

Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: I

Scheme: 2025

CO4	3	2							
CO5	2	2	2		2				

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3					2								
CO4				3					2								
CO5				3					2								

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: I

Scheme: 2025

Course Title	Differential Calculus and Linear Algebra (ME, IEM, AE)						
Course Code	1BMAU101C						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills of employing basic tools of differential calculus, linear algebra, and differential equations to solve basic and complex engineering problems.
CLO2	Understand elementary matrix transformations, echelon form, rank, system of linear equations, and dominant eigenvalues using Rayleigh's power method.
CLO3	Develop analytical skills for polar curves, pedal equations, curvature, and radius of curvature.
CLO4	Solve first-order exact and reducible exact differential equations, and find orthogonal trajectories in cartesian and polar forms.
CLO5	Analyze higher-order linear differential equations with constant coefficients, Cauchy's equations, Taylor's and Maclaurin's series, partial differentiation, and Jacobians.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Linear Algebra Elementary row transformation of a matrix, echelon form, rank of a matrix. Consistency, solution of system of linear equations – Gauss elimination method. Rayleigh's power method to find the dominant eigenvalue and eigenvector.		
SELF-STUDY COMPONENTS: Eigenvalues and eigenvectors. Normal form and solution of system of linear equations by Gauss-Jordan method.		
UNIT 2	8	L1-L4
Polar Curves and Curvature Polar coordinates, polar curves, angle between the radius vector and the tangent, angle between two polar curves. Pedal equations. Curvature and Radius of curvature-cartesian and pedal forms (without proof).		
SELF-STUDY COMPONENTS: Radius of curvature-polar form, Tracing of curves (cartesian, parametric and polar).		
UNIT 3	8	L1-L4
Ordinary Differential Equations of First Order Exact and reducible to exact differential equations with integrating factors: $\frac{1}{N} \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} \right)$ and $-\frac{1}{M} \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} \right)$ only. Orthogonal trajectories – Cartesian form and polar form.		
SELF-STUDY COMPONENTS: Bernoulli's differential equation. Reducible to exact-IF by inspection.		
UNIT 4	9	L1-L4

Ordinary Differential Equations of Higher Order

Higher order linear differential equations with constant coefficients-homogeneous and non-homogeneous, inverse differential operator: e^{ax} , $\sin(ax+b)$ or $\cos(ax+b)$, x^n only. Cauchy's homogeneous differential equations.

SELF-STUDY COMPONENTS: Method of variation of parameters. Legendre's non-homogeneous differential equations.

UNIT 5	9	L1-L4
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Series Expansion and Multivariable Calculus

Statement and problems on Taylor's and Maclaurin's series expansion for one variable. Partial differentiation, Euler's theorem. Total derivative – differentiation of composite functions, Jacobian.

SELF-STUDY COMPONENTS: Maxima and Minima for the function of two variable. Extended Euler's theorem.

Practical Component

Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.

1	Analyzing standard 2D curves in polar, parametric and Cartesian forms. Also determining the point of intersection, nature of tangent and angle between polar curves.
2	Evaluation of bending of curves and nature at a given point on it.
3	Determination of flow of a multivariable function along the given direction and also identify the independence of given multivariable functions.
4	Determination of the optimal values of unconstrained function of at most two variables.
5	Determine the primitive of first order differential equations.
6	Solution of higher order ordinary differential equations.
7	Identifying the nature of given set of lines or planes using rank method.
8	Finding all the eigenvalues of a square matrix of order up to four using Rayleigh power method.
9	Solution of second order ordinary differential equations by variation of parameter.
10	Solution of simultaneous differential equations.

TEXT BOOKS:

1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	Gilbert Strang, Linear Algebra and its Applications, Cengage Publications, 4th Ed., 2022.

REFERENCE BOOKS:

1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	N. P Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
3	James Stewart, Calculus, Cengage Publications, 7th Ed., 2019.

e-LEARNING RESOURCES:

1	http://academicearth.org/
2	VTU e-Shikshana Program & VTU EDUSAT Program

Assessment Details both (CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.

CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE.

Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	30		12
Laboratory components	Rubrics for experiment are added, then taken average	10	20	08
	Lab CIE	10		
TOTAL		50		20

QUESTION PAPER PATTERN (SEE)

Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

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

CO1	Learn the concept of matrix theory for solving the system of linear equations, eigenvalues and eigenvectors.
CO2	Understand the concept of polar curves, pedal equations curvature and radius of curvature.
CO3	Apply the concept of differential equations to study exact differential equations and orthogonal trajectories.
CO4	Analyze the higher order differential equations with constant coefficients in terms of homogeneity and non-homogeneity.
CO5	Develop the power series of a function of a single variable, study partial differentiation, Jacobian for multivariable functions and the modern mathematical tool – wxMAXIMA.

Mapping of CO's, PO's with PSO's

Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2												
CO2	2	3												
CO3	2	2												
CO4	2	3												
CO5	1	1	2		2									

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: I

Scheme: 2025

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							
CO4	3	2							
CO5	2	2	2		2				

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3					2								
CO4				3					2								
CO5				3					2								

Course Title	Differential Calculus and Linear Algebra (EE, EC, ET, EI, VLSI)						
Course Code	1BMAU101D						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills of employing basic tools of differential calculus, linear algebra, multiple integrals, and differential equations to solve basic and complex engineering problems with related applications.
CLO2	Understand elementary matrix transformations, echelon form, rank, system of linear equations, and dominant eigenvalues using Rayleigh's power method.
CLO3	Develop analytical skills for polar curves, pedal equations, curvature, and radius of curvature in cartesian, polar, and pedal forms.
CLO4	Solve first-order exact and reducible differential equations, orthogonal trajectories, and electrical application problems like L-R and C-R circuits.
CLO5	Analyze higher-order linear differential equations with constant coefficients, Cauchy's equations, L-C-R circuits, Taylor's & Maclaurin's series, partial differentiation, and Jacobians.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Linear Algebra Elementary row transformation of a matrix, echelon form, rank of a matrix. Consistency, solution of system of linear equations – Gauss elimination method. Rayleigh's power method to find the dominant eigenvalue and eigenvector.		
SELF-STUDY COMPONENTS: Eigenvalues and eigenvectors. Normal form and solution of system of linear equations by Gauss-Jordan method.		
UNIT 2	8	L1-L4
Polar Curves and Curvature Polar coordinates, polar curves, angle between the radius vector and the tangent, angle between two polar curves. Pedal equations. Curvature and Radius of curvature-cartesian and pedal forms (without proof).		
SELF-STUDY COMPONENTS: Radius of curvature-polar form, Tracing of curves (cartesian, parametric and polar).		
UNIT 3	8	L1-L4
Ordinary Differential Equations of First Order Exact and reducible to exact differential equations with integrating factors: $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ and $-\frac{1}{M}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ only. Orthogonal trajectories, L-R circuits and C-R circuits.		
SELF-STUDY COMPONENTS: Bernoulli's differential equation. Reducible to exact-IF by inspection.		
UNIT 4	9	L1-L4

Ordinary Differential Equations of Higher Order

Higher order linear differential equations with constant coefficients-homogeneous and non-homogeneous, inverse differential operator: e^{ax} , $\sin(ax+b)$ or $\cos(ax+b)$, x^n only. Cauchy's homogeneous differential equations. L-C-R circuits.

SELF-STUDY COMPONENTS: Method of variation of parameters. Legendre's non-homogeneous differential equations.

UNIT 5	9	L1-L4
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Series Expansion and Multivariable Calculus

Statement and problems on Taylor's and Maclaurin's series expansion for one variable. Partial differentiation, Euler's theorem. Total derivative – differentiation of composite functions, Jacobian.

SELF-STUDY COMPONENTS: Maxima and Minima for the function of two variable. Extended Euler's theorem.

Practical Component

Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.

1	Analyzing standard 2D curves in polar, parametric and Cartesian forms. Also determining the point of intersection, nature of tangent and angle between polar curves.
2	Evaluation of bending of curves and nature at a given point on it.
3	Determination of flow of a multivariable function along the given direction and also identify the independence of given multivariable functions.
4	Determination of the optimal values of unconstrained function of at most two variables.
5	Determine the primitive of first order differential equations
6	Solution of higher order ordinary differential equations.
7	Identifying the nature of given set of lines or planes using rank method.
8	Finding all the eigenvalues of a square matrix of order up to four using Rayleigh power method.
9	Evaluation of triple integrations, finding average values and centroid.
10	Evaluation of gamma and beta functions.

TEXT BOOKS:

1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	Gilbert Strang, Linear Algebra and its Applications, Cengage Publications, 4th Ed., 2022.

REFERENCE BOOKS:

1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	N. P Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
3	James Stewart, Calculus, Cengage Publications, 7th Ed., 2019.

e-LEARNING RESOURCES:

1	http://academicearth.org/
2	VTU e-Shikshana Program & VTU EDUSAT Program

Assessment Details both (CIE and SEE)			
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks. **Self-Study Component should be not included for SEE & CIE.			
CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	30	12
Laboratory components	Rubrics for experiment are added, then taken average	10	20
	Lab CIE	10	
TOTAL		50	20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Learn the concept of matrix theory for solving the system of linear equations, eigenvalues and eigenvectors.
CO2	Understand the concept of polar curves, pedal equations curvature and radius of curvature.
CO3	Apply the concept of differential equations to study exact differential equations and orthogonal trajectories.
CO4	Analyze the higher order differential equations with constant coefficients in terms of homogeneity and non-homogeneity.
CO5	Develop the power series of a function of a single variable, study partial differentiation, Jacobian for multivariable functions and the modern mathematical tool – wxMAXIMA.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2												
CO2	2	3												
CO3	2	2												
CO4	2	3												
CO5	1	1	2		2									

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							
CO4	3	2							
CO5	2	2	2		2				

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3					2								
CO4				3					2								
CO5				3					2								

Course Title	Differential Calculus and Numerical Methods (CV)						
Course Code	1BMAU201A						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills of employing basic tools of integral calculus, vector calculus, partial differential equations, and numerical techniques to solve basic and complex engineering problems with related applications.
CLO2	Understand evaluation of double and triple integrals, Beta and Gamma functions, and area computation.
CLO3	Apply vector differentiation concepts (gradient, divergence, curl) and vector integration (line integrals, Green's theorem).
CLO4	Solve algebraic, transcendental, and interpolating equations using numerical methods.
CLO5	Execute numerical integration and numerical solution of ODEs along with formation and solution of partial differential equations (PDEs).

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Integral Calculus and its Applications Multiple Integrals: Evaluation of double and triple integrals, double integrals over the region, changing into polar coordinates. Applications to find area by double integration. Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. SELF-STUDY COMPONENTS: Volume by double integration, duplication formula.		
UNIT 2	8	L1-L4
Vector Calculus and its Applications Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, divergence and curl. Solenoidal vector fields, irrotational vector fields. Vector Integration: Line integrals, work done by a force and flux. Statements of Green's theorem - problems. SELF-STUDY COMPONENTS: Stoke's theorem. Vector identities, divergence theorem.		
UNIT 3	8	L1-L4
Numerical Methods-1 Solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method. Interpolation: Finite differences. Interpolation using Newton's forward and backward difference formulae, Lagrange's interpolation formula. SELF-STUDY COMPONENTS: Secant method, Newton's divided difference formula, inverse Lagrange's interpolation formula.		
UNIT 4	9	L1-L4
Numerical Methods-2 Numerical Integration: Trapezoidal, Simpson's 1/3rd rule and Simpson's 3/8th rule. Numerical solution		

of ordinary differential equations of first order and first degree: Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector method.

SELF-STUDY COMPONENTS: Taylor's method and Euler's method to solve ODE of first order and first degree.

UNIT 5	9	L1-L4
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Partial Differential Equations (PDE)

Formation of PDEs by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Applications of PDE: Solution of one-dimensional heat equation and wave equation.

SELF-STUDY COMPONENTS: Solution of PDE by Lagrange method.

Practical Component

Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.

1	Evaluation of multiple integrals and application to determine area, volume and surface area of standard objects.
2	Evaluation of Gamma and Beta functions.
3	Vector differential operator applied on scalar and vector point functions.
4	Application problems on vector differential operator.
5	Solution of algebraic and transcendental equations by Regula-falsi and Newton-Raphson method.
6	Interpolation/Extrapolation using Newton's forward and backward difference formula.
7	Application of quadrature formula.
8	Solution of linear first order ordinary differential equations by Runge-Kutta IV order and Milne's predictor-corrector methods.
9	Solution of linear first order ordinary differential equations by Modified Euler's method.
10	Solution of one-dimensional heat equation and wave equation.

TEXT BOOKS:

1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44 th Ed., 2021.
2	E. Kreyszig, Advanced Engineering Mathematics, John Wiley and sons, 10 th Ed., 2018

REFERENCE BOOKS:

1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11 th Ed., 2017
2	Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 3 rd Ed., 2016.
3	N. P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, 10 th Ed., 2022.

e-LEARNING RESOURCES:

1	http://academicearth.org/
2	VTU e-Shikshana Program

Assessment Details both (CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each.

The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE.

Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	30		12
Laboratory components	Rubrics for experiment are added, then taken average	10	20	08
	Lab CIE	10		
TOTAL		50		20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply the knowledge of multiple integrals to compute area and volume, vector differential operator to evaluate gradient, divergence, curl and numerical differences to evaluate interpolation problems.
CO2	Understand the knowledge of formation of partial differential equations, vector calculus refers to solenoidal, irrotational vectors and improper integrals.
CO3	Demonstrate the various methods of solution of partial differential equations, numerical methods to solve algebraic and transcendental equations.
CO4	Analyze the concept of multiple integrals, improper integrals, vector differentiation and vector integration to solve relevant problems.
CO5	Develop the skill of programming using the mathematical tool- wxMAXIMA, the concept of numerical methods to estimate the interpolating polynomial, to find the approximate solution of initial value problems and numerical integration.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2												
CO2	2	3												
CO3	2	2												
CO4	2	3												
CO5	1	1	2		2									

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							
CO4	3	2							
CO5	2	2	2		2				

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3					2								
CO4				3					2								
CO5				3					2								

Course Title	Numerical Methods (CSE, ISE, CSBS, CSDS, AIML)						
Course Code	1BMAU201B						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills of employing basic tools of differential equations, modular arithmetic, and numerical techniques to solve basic and complex engineering problems with related applications.
CLO2	Understand error analysis and evaluation of algebraic, transcendental, and interpolating equations using numerical methods.
CLO3	Apply numerical integration rules and numerical methods for ordinary differential equations (ODEs).
CLO4	Solve exact and higher-order linear differential equations with constant coefficients.
CLO5	Understand modular arithmetic concepts including congruences, linear Diophantine equations, and key number theory theorems.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Introduction to Numerical Methods Errors and their computation: Round off error, Truncation error, Absolute error, Relative error and Percentage error. Solution of algebraic and transcendental equations: Bisection, Regula-falsi, Secant and Newton-Raphson methods.		
SELF-STUDY COMPONENTS: Solution of equations by Ramanujan's method.		
UNIT 2	8	L1-L4
Interpolation Finite differences, interpolation using Newton Gregory forward and backward difference formulae, Newton's divided difference. Lagrange interpolation formulae, Gauss interpolation formulae.		
SELF-STUDY COMPONENTS: Numerical Differentiation.		
UNIT 3	8	L1-L4
Numerical Integration and Numerical Solution of Differential Equations Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule and Weddle's rule. Numerical solution of ordinary differential equations of first order and first degree: Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector method.		
SELF-STUDY COMPONENTS: Adam's Bashforth predictor and corrector method.		
UNIT 4	9	L1-L4
Differential Equations of First and Higher order		

Exact and reducible to exact differential equations with integrating factors. coefficients. $\frac{1}{N} \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} \right)$ and $-\frac{1}{M} \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} \right)$ only. Homogeneous and non-homogeneous differential equations of higher order with constant coefficients. Inverse differential operator: e^{ax} , $\sin(ax + b)$ or $\cos(ax + b)$, x^n only.

SELF-STUDY COMPONENTS: Variation of parameter method.

UNIT 5	9	L1-L4
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Modular Arithmetic

Introduction to congruences. Linear Diophantine equations, basic properties of congruences. Linear congruences, system of linear congruences - Chinese Remainder theorem (no proof). Fermat's little theorem.

SELF-STUDY COMPONENTS: Wilson theorem. Euler's theorem on congruences.

Practical Component	
Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions + 1 repetition class + 1 Lab Assessment.	
1	Computation of different types of error in numerical methods
2	Solution of algebraic and transcendental equations by Regula-falsi and Newton-Raphson method.
3	Interpolation using Newton's forward, backward difference formula and central difference formula.
4	Interpolation using Lagrange's formula.
5	Application of quadrature formula.
6	Solution of linear first order ordinary differential equations by Modified Euler's method.
7	Solution of linear first order ordinary differential equations by Runge-Kutta IV order and Milne's predictor-corrector methods.
8	Determination of the primitive of first order differential equations.
9	Solution of higher order homogeneous and non-homogeneous linear differential equations.
10	Application of linear Diophantine equations and linear congruences.

TEXT BOOKS:

1	M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 8th Ed., 2022.
2	David C Lay, Linear Algebra and its Applications, Pearson Publishers, 5th Ed., 2023.

REFERENCE BOOKS:

1	B.V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
3	S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, 5th Ed., 2012.

e-LEARNING RESOURCES:

1	http://academicearth.org/
2	VTU e-Shikshana Program & VTU EDUSAT Program

Assessment Details both (CIE and SEE)					
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks. **Self-Study Component should be not included for SEE & CIE.					
CONTINUOUS INTERNAL EVALUATION (CIE)			Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3		30		12
Laboratory components	Rubrics for experiment are added, then taken average		10	20	08
	Lab CIE		10		
TOTAL			50		20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply the knowledge to compute various types of numerical errors, interpolation problems, congruence related problems.
CO2	Understand the knowledge of differential equations, modular arithmetic, numerical methods to solve relevant problems.
CO3	Demonstrate the idea of numerical methods to solve algebraic and transcendental equations, numerical ordinary differential equations.
CO4	Analyze the concept of differential equations, numerical integrations to solve domain related problems.
CO5	Develop the skill of programming using the mathematical tool- wxMAXIMA, the concept of numerical methods to estimate the interpolating polynomial, to find the approximate solution of initial value problems and numerical integration.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
co	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
co1	2	1												
co2	3	2												
co3	2	3												
co4	3	2												
co5	2	1			3									

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
C01	3	2							
C02	3	2							
C03	3	2							
C04	3	2							
C05	2	2	2		3				

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
C01				3													
C02				3													
C03				3					2								
C04				3					2								
C05				3					2								

Course Title	Multivariable Calculus and Numerical Methods (ME, IEM, AE)						
Course Code	1BMAU201C						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills to employ basic tools of integral calculus, vector calculus, partial differential equations and numerical techniques to solve basic and complex engineering problems.
CLO2	Introduce concepts of multiple integrals, Beta and Gamma functions and their applications to evaluate area and volume.
CLO3	Apply vector calculus concepts including gradient, divergence, curl, line integrals, work done and flux to engineering domain problems.
CLO4	Develop numerical skills for solving algebraic, transcendental equations, interpolation, numerical integration and initial value problems of ODEs.
CLO5	Understand formation and solution of partial differential equations and utilize modern mathematical tools (wxMAXIMA) for problem solving.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Integral Calculus and its Applications Multiple Integrals: Evaluation of double and triple integrals, double integrals over the region, changing into polar coordinates. Applications to find area by double integration. Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions (only derivations). SELF-STUDY COMPONENTS: Volume by double integration, duplication formula.		
UNIT 2	8	L1-L4
Vector Calculus and its Applications Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, divergence and curl. Solenoidal vector fields, irrotational vector fields. Vector Integration: Line integrals, work done by a force and flux. Statements of Green's theorem – problems without verification. SELF-STUDY COMPONENTS: Stoke's theorem. Vector identities, divergence theorem.		
UNIT 3	8	L1-L4
Numerical Methods - 1 Solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method. Interpolation: Finite differences. Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula. SELF-STUDY COMPONENTS: Secant method, Lagrange's interpolation formula.		

UNIT 4	9	L1-L4
Numerical Methods - 2 Numerical Integration: Trapezoidal, Simpson's 1/3rd rule and Simpson's 3/8th rule. Numerical solution of ordinary differential equations of first order and first degree: Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector method. SELF-STUDY COMPONENTS: Euler's method to solve ODE of first order and first degree.		
UNIT 5	9	L1-L4
Partial Differential Equations (PDE) Formation of PDEs by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Applications of PDE: Solution of one-dimensional heat equation and wave equation. SELF-STUDY COMPONENTS: Solution of PDE by Lagrange method.		

Practical Component	
Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.	
1	Evaluation of multiple integrals and application to determine area, volume and surface area of standard objects.
2	Evaluation of Gamma and Beta functions.
3	Vector differential operator applied on scalar and vector point functions and its application problems.
4	Application problems on vector differential operator.
5	Solution of algebraic and transcendental equations by Regula-falsi and Newton-Raphson method.
6	Interpolation/Extrapolation using Newton's forward and backward difference formula.
7	Application of quadrature formula.
8	Solution of linear first order ordinary differential equations by Runge-Kutta IV order and Milne's predictor-corrector methods.
9	Solution of linear first order ordinary differential equations by Modified Euler's method.
10	Solution of one-dimensional heat equation and wave equation.

TEXT BOOKS:	
1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	Gilbert Strang, Linear Algebra and its Applications, Cengage Publications, 4th Ed., 2022.

REFERENCE BOOKS:	
1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	N. P Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
3	James Stewart, Calculus, Cengage Publications, 7th Ed., 2019.
e-LEARNING RESOURCES:	
1	http://academicearth.org/
2	VTU e-Shikshana Program & VTU EDUSAT Program

Assessment Details both (CIE and SEE)					
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks. **Self-Study Component should be not included for SEE & CIE.					
CONTINUOUS INTERNAL EVALUATION (CIE)			Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3		30		12
Laboratory components	Rubrics for experiment are added, then taken average		10	20	08
	Lab CIE		10		
TOTAL			50		20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply the knowledge of multiple integrals to compute area and volume, vector differential operator to evaluate gradient, divergence, curl and numerical differences to evaluate interpolation problems.
CO2	Understand the knowledge of formation of partial differential equations, vector calculus refers to solenoidal, irrotational vectors and improper integrals.
CO3	Demonstrate the various methods of solution of partial differential equations, numerical methods to solve algebraic and transcendental equations.
CO4	Analyze the concept of multiple integrals, improper integrals, vector differentiation and vector integration to solve relevant problems.
CO5	Develop the skill of programming using the mathematical tool - wxMAXIMA, the concept of numerical methods to estimate the interpolating polynomial, to find the approximate solution of initial value problems, and numerical integration.

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: II

Scheme: 2025

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1												
CO2	3	2												
CO3	2	3												
CO4	3	2												
CO5	2	1			3									

Mapping of CO's with Knowledge and Attitude Profile (WK)										
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0										
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO1	3	2								
CO2	2	3								
CO3	2	2	1							
CO4	3	3								
CO5	2	2		3						

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3					2								
CO4				3					2								
CO5				3					2								

Course Title	Calculus, Laplace Transform and Numerical Techniques (EE, EC, ET, EI, VLSI)						
Course Code	1BMAU201D						
Course Category	IPCC (Integrated Professional Core Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	0	2	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:	
CLO1	Impart skills to employ basic tools of Laplace transform, vector calculus, integral calculus and numerical techniques to solve basic and complex engineering problems with related applications.
CLO2	Introduce evaluation of double and triple integrals, Beta and Gamma functions, and application to area computation.
CLO3	Apply vector differentiation and integration concepts including gradient, divergence, curl, line integrals, work done, and Green's theorem.
CLO4	Develop skills for solving algebraic/transcendental equations, interpolation, numerical integration, and numerical solution of first-order ODEs.
CLO5	Understand Laplace transforms, unit step functions, inverse Laplace transforms, and applications to solve ordinary differential equations.

SYLLABUS	No. of Hours	BTLs
UNIT 1	8	L1-L4
Integral Calculus and its Applications		
Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find area by double integration. Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions (only derivations).		
SELF-STUDY COMPONENTS: Volume by double integration, duplication formula.		
UNIT 2	8	L1-L4
Vector Calculus and its Applications		
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, divergence and curl. Solenoidal vector fields, irrotational vector fields.		
Vector Integration: Line integrals, work done by a force and flux. Statements of Green's theorem – problems without verification.		
SELF-STUDY COMPONENTS: Stoke's theorem, Vector identities, divergence theorem.		
UNIT 3	8	L1-L4
Numerical Methods - 1		
Solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method.		
Interpolation: Finite differences. Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula.		
SELF-STUDY COMPONENTS: Secant method, Lagrange's interpolation formula.		

UNIT 4	9	L1-L4
Numerical Methods - 2 Numerical Integration: Trapezoidal, Simpson's 1/3rd rule and Simpson's 3/8th rule. Numerical solution of ordinary differential equations of first order and first degree: Modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor-corrector method and Adams-Bashforth method. SELF-STUDY COMPONENTS: Euler's method to solve ODE of first order and first degree.		
UNIT 5	9	L1-L4
Laplace Transforms Laplace transform (LT): Definition, LT of elementary functions. Properties - linearity, scaling, shifting property, differentiation in the s domain, division by t (without proof). LT of Heaviside unit step function. Inverse Laplace transform: Definition, evaluation using partial fraction method and applications to solve ordinary differential equations (simple problems). SELF-STUDY COMPONENTS: Convolution theorem on Laplace transform.		

Practical Component		
Note: List of Laboratory experiments (2 hours/week per batch/batch strength 15): 10 lab sessions+ 1 repetition class+ 1 Lab Assessment.		
1	Evaluation of multiple integrals and application to determine area, volume and surface area of standard objects.	
2	Evaluation of Gamma and Beta functions.	
3	Vector differential operator applied on scalar and vector point functions.	
4	Application problems on vector differential operator.	
5	Solution of algebraic and transcendental equations by Regula-falsi and Newton-Raphson method.	
6	Interpolation/Extrapolation using Newton's forward and backward difference formula.	
7	Application of quadrature formula.	
8	Solution of linear first order ordinary differential equations by Runge-Kutta IV order and Milne's predictor-corrector methods.	
9	Computing Laplace transform and inverse Laplace transform of standard function.	
10	Laplace transform of convolution of two functions.	

TEXT BOOKS:	
1	B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2018.
REFERENCE BOOKS:	
1	B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	N. P Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
3	James Stewart, Calculus, Cengage Publications, 7th Ed., 2019.
e-LEARNING RESOURCES:	
1	http://academicearth.org/
2	VTU e-Shikshana Program & VTU EDUSAT Program

Assessment Details both (CIE and SEE)					
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.					
CIE: The CIE has two components – CIE - theory component and CIE – laboratory component. Students have to score a minimum of 40% Marks in the total of CIE - theory and CIE – laboratory components put together, provided students have to score a minimum of 40% marks in CIE laboratory component alone to qualify to take SEE.					
Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.					
**Self-Study Component should be not included for SEE & CIE.					
CONTINUOUS INTERNAL EVALUATION (CIE)			Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3		30		12
Laboratory components	Rubrics for experiment are added, then taken average		10	20	08
	Lab CIE		10		
TOTAL			50		20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5	6	7	8	9	10
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply the knowledge of Laplace transform to solve differential equations, vector differential operator to evaluate gradient, divergence, curl and numerical differences to evaluate interpolation problems.
CO2	Understand the knowledge of vector calculus refer to solenoidal, irrotational vectors and numerical differences to evaluate interpolation problems.
CO3	Demonstrate various properties to find the Laplace transforms, numerical methods to solve algebraic and transcendental equations.
CO4	Analyze the concept of Laplace transforms, vector differentiation and vector integration to solve relevant problems.
CO5	Develop the skill of programming using the mathematical tool - wxMAXIMA, the concept of numerical methods to estimate the interpolating polynomial, to find the approximate solution of initial value problems and numerical integration.

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: II

Scheme: 2025

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1												
CO2	3	2												
CO3	2	3												
CO4	3	2												
CO5	2	1			3									

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	2	3							
CO3	2	2	1						
CO4	3	3							
CO5	2	2		3					

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3													
CO4				3													
CO5				3				2									

Course Title	PROBABILITY AND STATISTICS (CV, ME, IEM, AE)						
Course Code	1BMAT301A						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	03	02	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	
Course Learning Objectives:							
This course is proposed to impart to the students the skills to identify and solve problems in their field of study involving the application of numerical and probability distribution techniques.							

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Statistical techniques: Curve fitting by method of least squares: $y = ax + b$, $y = ax^2 + bx + c$ and $y = ab^x$. Correlation–Karl Pearson’s coefficient of correlation, Regression analysis – lines of regression (without proof), angle between regression lines-problems.		
SELF-STUDY COMPONENTS: Rank correlation, Growth modeling.		
UNIT 2	10	L1-L4
Probability Distributions: Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation and variance. Binomial, Poisson, normal and exponential distributions- only problems		
SELF-STUDY COMPONENTS: Geometric and Gamma distributions, Application to transmission errors in noise media.		
UNIT 3	10	L1-L4
Joint Probability Distributions and Markov Chains: Introduction, Joint probability and Joint distribution of discrete random variables, Markov chains, Classification of Stochastic processes, Probability vector, Stochastic matrix, Regular stochastic matrix, Transition probabilities and Transition probability matrix.		
SELF-STUDY COMPONENTS: Joint probability and Joint distribution of continuous random variables.		
UNIT 4	10	L1-L4
Numerical Solutions of Partial Differential Equations: Solutions of Laplace equation-Gauss-Seidel method, one-dimensional heat equation- Bendre-Schmidt method. Wave Equation-Finite difference method.		
SELF-STUDY COMPONENTS: Solutions of Poisson equations, Finite element methods.		
UNIT 5	10	L1-L4
Calculus of variations: Variation of a function and a functional, Euler’s equation-standard variational problems, Geodesics on a plane surface and hanging cable problems.		
SELF-STUDY COMPONENTS: Isoperimetric problems, Rayleigh Ritz method -problems.		

TEXT BOOKS:	
1.	B. S. Grewal, Higher Engineering Mathematics. Khanna Publishers, New Delhi.
2.	E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons.
3.	Glyn James, Advanced modern Engineering Mathematics, Pearson Publications.
4.	S.S. Sastry, Introductory methods of numerical analysis, PHI.
5.	H.C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:	
1	B. V. Ramana, Higher Engineering Mathematics, McGraw–Hill Education.
2	Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press
3	C. Ray Wylie, Louis C. Barrett, Advanced Engineering Mathematics, McGraw Hill Book Co., New York
4	H.K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publication
e-LEARNING RESOURCES:	
1	http://nptel.ac.in/courses.php?disciplineID=111
2	http://www.class-central.com/subject/math(MOOCs)
3	VTU e-Shikshana Program
4	VTU EDUSAT Program

Assessment Details both (CIE and SEE)										
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE. SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks. **Self-Study Component should be not included for SEE & CIE.										
CONTINUOUS INTERNAL EVALUATION (CIE)						Max. Marks		Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)		
Theory	Weightage of CIE1 and CIE2 Tests or CIE3					50		20		
TOTAL						50		20		
QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply the Statistical techniques to obtain or fit a curve for the specified data. This helps the students to learn the numerical part of estimating the curve
CO2	Employ the knowledge of probability models arising in the engineering field using basic concepts of probability, random variables and probability distributions
CO3	Identify and solve problems involving random variables, probability distributions and Markov chains connected to digital signal processing, information code theory and structural engineering.
CO4	Apply numerical methods to identify and solve problems related to fluid mechanics, gas dynamics, heat and mass transfer, thermodynamics, vibrations, automatic control systems, kinematics, design etc
CO5	Analyze the basic concepts of calculus of variations, numerical and statistical methods.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	0	0	0	2	1	1	1	0	1		
CO2	3	3	2	0	0	0	2	1	1	1	0	1		
CO3	3	3	3	0	0	0	2	1	1	1	0	1		
CO4	3	3	3	0	0	0	2	1	1	1	0	1		
CO5	3	3	3	0	0	0	2	1	1	1	0	1		

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	3	0	0	0	2	1	1	1	0	1		
CO2	3	2	2	0	0	0	2	1	1	1	0	1		
CO3	2	3	3	0	0	0	2	1	1	1	0	1		
CO4	3	2	3	0	0	0	2	1	1	1	0	1		
CO5	2	3	3	0	0	0	2	1	1	1	0	1		

Mapping of CO's with Knowledge and Attitude Profile (WK)										
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0										
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO1	3	3	2	1	0	0	0	0	0	
CO2	2	3	3	1	0	0	0	0	0	
CO3	2	3	3	2	1	0	0	0	0	
CO4	2	2	2	3	1	1	1	0	0	
CO5	2	3	3	3	2	1	1	1	1	

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0
CO2	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO3	0	0	0	2	0	0	0	0	3	0	0	0	1	0	0	0	0
CO4	0	0	1	2	0	0	0	1	2	0	0	0	0	0	0	0	0
CO5	0	0	0	2	0	0	0	1	3	0	1	0	1	0	0	0	0

Course Title	Probability and Statistical Inference						
Course Code	1BMAT301B						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	2	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:

This course is proposed to impart to the students the skills to identify and solve real life problems in their field of study involving the application of the concepts of probability, statistical inferences and ANOVA testing.

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Probability Distributions: Random Variables, moment generating function, expectations. Discrete probability distributions - Binomial, Poisson and Geometric distributions, Continuous probability distributions-Exponential and Normal distributions.		
SELF-STUDY COMPONENTS: Gamma and Weibull distributions. Transmission errors in noise media.		
UNIT 2	10	L1-L4
Two-dimensional Random variables: Joint probability mass function, marginal probability function, covariance and correlation coefficient. Random Process: Classification of random process, description of random process, stationary random process – first order and wide sense stationary processes, Autocorrelation function.		
SELF-STUDY COMPONENTS: Joint density function, marginal and conditional probability density function. Cross-correlation function.		
UNIT 3	10	L1-L4
Statistical Inference: Sampling distribution, standard errors, level of significance, confidence limits, testing of hypothesis- test of significance for large samples, testing of mean and proportion of single population and difference of means and propulsions, students t-distribution.		
SELF-STUDY COMPONENTS: F-distribution, Chi-square distribution - goodness of fit.		
UNIT 4	10	L1-L4
Markov Chain: Introduction to stochastic process, probability vectors, stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.		
SELF-STUDY COMPONENTS: Regular stochastic matrices. Model the behavior of stock prices.		
UNIT 5	10	L1-L4

Design of Experiments and ANOVA: Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, basic principle of ANOVA, One way ANOVA, Two-way ANOVA.

SELF-STUDY COMPONENTS:

Latin-square design. To test effectiveness of different marketing strategies.

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Kishore S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, Wiley India publication.
3. V. Sundarapandian, Probability, Statistics and Queuing theory, PHI Learning.
4. G. Hari Baskaran, Probability Queuing Theory and Reliability Engineering, Lakshmi publications.
5. Peter Bruce, Andrew Bruce and Peter Gedeck, Practical Statistics for Data Scientists, O'REILLY.

REFERENCE BOOKS:

- | | |
|---|---|
| 1 | B. V. Ramana, Higher Engineering Mathematics, McGraw–Hill Education. |
| 2 | Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press. |
| 3 | C. Ray Wylie, Louis C. Barrett, Advanced Engineering Mathematics, McGraw Hill Book Co., New York. |
| 4 | H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publication |

e-LEARNING RESOURCES:

- | | |
|---|---|
| 1 | https://nptel.ac.in/courses/111106051 |
| 2 | https://nptel.ac.in/courses/106106179 |
| 3 | VTU e-Shikshana Program |
| 4 | https://nptel.ac.in/courses/111106102 |

Assessment Details both (CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.

CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE.

SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	50	20
TOTAL		50	20

QUESTION PAPER PATTERN (SEE)

Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

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

CO1	Identify and solve problems involving random variables, probability distributions and its applications.
CO2	Analyze random processes and understand two dimensional random variables.
CO3	Understand the concept of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered problems.
CO4	Apply the knowledge of stochastic processes and Markov chain in Mathematical modeling.
CO5	Examine the principles of experimentation in design and understand the different ANOVA techniques.

Mapping of CO's, PO's with PSO's**Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	2	1
CO2	3	2	0	0	0	0	0	0	0	0	0	0	2	2
CO3	2	3	0	0	0	0	0	0	0	0	0	0	2	2
CO4	3	2	0	0	0	0	0	0	0	0	0	0	2	2
CO5	2	3	0	0	0	0	0	0	0	0	0	0	2	2

Mapping of CO's with Knowledge and Attitude Profile (WK)**Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	3	2	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0
CO3	3	3	2	0	0	0	0	0	0
CO4	3	3	2	0	0	0	0	0	0
CO5	3	3	2	0	0	0	0	0	0

Mapping of CO's with Sustainable Development Goals (SDG)**Strength of correlation:** Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0
CO2	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0
CO3	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO5	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
School of Applied Science and Humanities
Programme: Mathematics

Semester: III

Scheme: 2025

Course Title	Transforms and Statistical Techniques (EE, EC, ET, EI, VLSI)						
Course Code	1BMAT301D						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	2	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:

This course is proposed to impart to the students the skills of employing the basic tools of Fourier series, Fourier transform, Z-transform, probability distributions, and Statistical techniques to solve basic and complex engineering problems with related applications.

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Statistical techniques: Curve fitting by method of least squares: Curve fitting by method of least squares: $y = ax + b$, $y = ax^2 + bx + c$ and $y = ab^x$. Correlation–Karl Pearson’s coefficient of correlation, Regression analysis – lines of regression (without proof), angle between regression lines-problems.		
SELF-STUDY COMPONENTS: Rank correlation, Growth modeling.		
UNIT 2	10	L1-L4
Probability Distributions: Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation and variance. Binomial, Poisson, normal and exponential distributions- only problems.		
SELF-STUDY COMPONENTS: Geometric and Gamma distributions, Application to transmission errors in noise media.		
UNIT 3	10	L1-L4
Fourier series: Periodic function, Dirichlet’s condition, conditions for a Fourier series expansion, Fourier series of functions with arbitrary period and half range Fourier series (without proof). Practical harmonic analysis.		
SELF-STUDY COMPONENTS: Typical waveforms, complex form of Fourier series.		
UNIT 4	10	L1-L4
Fourier Transforms: Definition, infinite Fourier transforms, inverse Fourier transforms, Fourier sine and cosine transforms, inverse Fourier sine and cosine transforms.		
SELF-STUDY COMPONENTS: Fourier transform of derivatives, solution of boundary value problems. Parseval’s identity.		
UNIT 5	10	L1-L4
Z-Transforms: Definition, Z-transforms of basic sequences and standard functions. Properties- linearity, scaling, first and second shifting, multiplication by n (without proof), initial and final value theorems. Inverse Z-transforms. Application to solve first order difference equation using Z-transforms		

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Semester: III

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SELF-STUDY COMPONENTS:

Formation of linear difference equations with constant coefficients.

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics Khanna Publishers, New Delhi.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons.
3. Glyn James, Advanced modern Engineering Mathematics, Pearson Publications,
4. H.C. Taneja, Advanced Engineering Mathematics, volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1	B. V. Ramana, Higher Engineering Mathematics, McGraw–Hill Education..
2	Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press
3	C. Ray Wylie, Louis C. Barrett, Advanced Engineering Mathematics, McGraw Hill Book Co., New York
4	H.K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publication

e-LEARNING RESOURCES:

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

Assessment Details both (CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.
CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE.
SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.
****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	50	20
TOTAL		50	20

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QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply the Statistical techniques to obtain or fit a curve for the specified data. This helps the students to learn the numerical part of estimating the curve
CO2	Employ the knowledge of probability models arising in the engineering field using basic concepts of probability, random variables and probability distributions
CO3	Develop the Fourier series to study the behavior of periodic functions and domain related applications.
CO4	Learn Fourier transforms and its applications to solve boundary value problem.
CO5	Analyze Z-transforms and its properties and apply the same to solve difference equations.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	2	1	0
CO2	3	2	1	0	0	0	0	0	0	0	0	2	2	0
CO3	2	3	1	0	0	0	0	0	0	0	0	2	2	0
CO4	3	2	1	0	0	0	0	0	0	0	0	2	2	0
CO5	2	3	1	0	0	0	0	0	0	0	0	2	2	0

Mapping of CO's with Knowledge and Attitude Profile (WK)										
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0										
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO1	3	3	2	0	0	0	0	0	0	
CO2	3	3	2	0	0	0	0	0	0	
CO3	3	3	2	0	0	0	0	0	0	
CO4	3	3	2	0	0	0	0	0	0	
CO5	3	3	2	0	0	0	0	0	0	

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0
CO2	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0
CO3	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO5	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0

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Course Title	DISCRETE MATHEMATICAL STRUCTURES (CSE, ISE, CSBS, CSDS, AIML)						
Course Code	1BMAT401B						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	03	02	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:
This course is proposed to enhance the student's ability to think logically, mathematically and algorithmically and use the concepts of discrete mathematical structures to solve problems connected to computer and information science and engineering.

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Fundamentals of Logic Propositions, logical connectives, tautologies, contradictions, logical equivalence, laws of logic, inverse, converse and contrapositive. Logical implication – Rules of inference. Quantifiers and types of quantifiers. Applications: Applications to switching networks.		
SELF-STUDY COMPONENTS: Proofs of theorems - method of direct and indirect proofs.		
UNIT 2	10	L1-L4
Set Theory and Mathematical Induction Sets, subsets, set operations, laws of set theory. The well ordering principle, principle of mathematical induction. Applications: Applications to recursive relations - Fibonacci, Lucas numbers.		
SELF-STUDY COMPONENTS: Axioms of probability.		
UNIT 3	10	L1-L4
Relations and Functions Cartesian product, relations, equivalence relation and partition. Partial order, Poset, Hasse diagram. Functions, one-one and onto functions, composition of functions. Applications: Computer recognition - zero-one matrices and directed graphs.		
SELF-STUDY COMPONENTS: Pigeonhole principle, Stirling numbers.		
UNIT 4	10	L1-L4
Introduction to Graph Theory Definition of a graph and examples. Degree of a vertex and degree sequence - Hakimi's theorem (without proof). Standard graphs - complete graph, regular graph, bipartite graph. Graph isomorphism, complement of a graph. Sub graph, spanning sub graph. Walk, trail, path, cycle, connectedness, Euler and Hamiltonian graph. Applications: Konigsberg bridge problem, seating arrangement problem.		

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SELF-STUDY COMPONENTS:

Operation on graphs - union, intersection, ring sum, Cartesian product, deletion and addition of edge/vertex.

UNIT 5	10	L1-L4
Planar Graphs, Matrix Representation and Graph Coloring Planar Graphs, Matrix Representation of a Graph - Adjacency matrix, Incidence matrix, Circuit Matrix, Fundamental circuit matrix - properties and rank. Vertex and Edge Coloring, Chromatic Polynomial. Applications: Scheduling Problem.		
SELF-STUDY COMPONENTS: Laplacian-matrix, Four color theorem, Chromatic-Partitioning.		

TEXT BOOKS:

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education, 2004.
2. J. P. Tremblay and R. Manohar: Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill.
3. Gary Chartrand and Ping Zhang: Introduction to Graph Theory, Tata McGraw-Hill Edition, 2006.

REFERENCE BOOKS:

1	Narsingh Deo: Graph Theory with Applications to Engineering and Computer Science, PHI, 1979.
2	C. L. Liu & D. P. Mohapatra: Elements of Discrete Mathematics, A Computer Oriented Approach, The McGraw-Hill Companies.
3	Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.

e-LEARNING RESOURCES:

1	https://onlinecourses.nptel.ac.in/noc20_cs82/preview
2	https://nptel.ac.in/courses/106108227
3	https://archive.nptel.ac.in/courses/111/106/111106102/
4	https://www.youtube.com/watch?v=sWsXBY19o8I

Assessment Details both (CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.

CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE.

SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)	Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
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Theory	Weightage of CIE1 and CIE2 Tests or CIE3	50	20
TOTAL		50	20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Demonstrate the knowledge of fundamental concepts in logics and inference to solve discrete mathematical problems.
CO2	Apply the concepts of logics, inference, mathematical induction, set theory and graph theory to solve domain specific problems.
CO3	Analyze the given problem to find the solution by suitable discrete mathematical concepts.
CO4	Examine the given concepts related to mapping and graph theory.
CO5	Develop recursive relations, directed graphs and variety of algorithms using appropriate technology.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	2	1
CO2	3	2	0	0	0	0	0	0	0	0	0	0	2	2
CO3	2	3	0	0	0	0	0	0	0	0	0	0	2	2
CO4	3	2	0	0	0	0	0	0	0	0	0	0	2	2
CO5	2	3	0	0	0	0	0	0	0	0	0	0	2	2

Mapping of CO's with Knowledge and Attitude Profile (WK)										
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0										
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO1	3	3	2	0	0	0	0	0	0	
CO2	3	3	2	0	0	0	0	0	0	
CO3	3	3	2	0	0	0	0	0	0	
CO4	3	3	2	0	0	0	0	0	0	
CO5	3	3	2	0	0	0	0	0	0	

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Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3					1								
CO2				3					1								
CO3				3					2								
CO4				3					2								
CO5				3					2								

Course Title	Complex Analysis and Numerical Techniques (EC, ET, EI, VLSI)						
Course Code	1BMAT401D						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	03	02	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:

This course is proposed to impart to the students the skills to identify and solve problems in their field of study involving the application of numerical and probability distribution techniques.

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Functions of a Complex Variable: Definitions of continuity, differentiability and analytic functions, Cauchy-Riemann equations in Cartesian and polar forms, properties of analytic functions: Harmonic functions and orthogonality. Construction of analytic functions (Milne-Thomson method).		
SELF-STUDY COMPONENTS: Complex potential. Flow problems.		
UNIT 2	10	L1-L4
Conformal Transformation: Bilinear Transformations, Discussion of transformations: $w = z^2$, $w = e^z$ and $w = z + 1/z$ ($z \neq 0$).		
Complex Integration: Complex line integrals-Cauchy's theorem and Cauchy's integral formula. Poles and Residues, Residue theorem (without proof).		
SELF-STUDY COMPONENTS: Complex integration in fluid dynamics.		
UNIT 3	10	L1-L4
Numerical Methods: Error analysis- Round off error, Truncation error, Absolute error, Relative error and percentage error. Numerical solution of simultaneous first order ordinary differential equations using Picard's method and Runge-Kutta method, Numerical solution of ordinary differential equations of second order using Runge-Kutta method and Milne's method (No derivations).		
SELF-STUDY COMPONENTS: Runge-Kutta method of third-order.		
UNIT 4	10	L1-L4
Numerical Solutions of Partial Differential Equations: Solutions of Laplace and Gauss-Seidel method, one-dimensional heat equation-Bendre-Schmidt method and Crank-Nicholson method. Wave Equation-Finite difference method.		
SELF-STUDY COMPONENTS: Solutions of Laplace and Poisson equations- Jacobi's method.		
UNIT 5	10	L1-L4

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Joint Probability Distributions and Markov Chains: Introduction, Joint probability and Joint distribution of discrete random variables, Classification of Stochastic processes, Probability vector, Stochastic matrix, Regular stochastic matrix, Transition probabilities and Transition probability matrix, Markov chains.

SELF-STUDY COMPONENTS:

Joint probability and Joint distribution of continuous random variables. Joint Probability distribution in Mathematical modelling.

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
2. B. S. Grewal, Numerical methods in engineering and science, Khanna Publishers, New Delhi.
3. E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons.
4. S.S. Sastry, Introductory methods of numerical analysis, PHI learning Pvt. Ltd.
5. H.C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

- | | |
|---|--|
| 1 | B. V. Ramana, Higher Engineering Mathematics, McGraw–Hill Education.. |
| 2 | Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press |
| 3 | C. Ray Wylie, Louis C. Barrett, Advanced Engineering Mathematics, McGraw Hill Book Co., New York |
| 4 | H.K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publication |

e-LEARNING RESOURCES:

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

Assessment Details both (CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.

CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE.

SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)	Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
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Semester: IV

Scheme: 2025

Theory	Weightage of CIE1 and CIE2 Tests or CIE3	50	20
TOTAL		50	20

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Understand basic concepts of Complex functions, analytic functions, harmonic functions and orthogonality of complex valued functions.
CO2	Analyze the concept of conformal mappings and Integrals of complex valued functions.
CO3	Demonstrate the existence of errors in numerical calculations and understand the methods to solve simultaneous and second order ODE's numerically
CO4	Apply numerical methods to identify and solve problems related to vibrations, automatic control systems, design etc.
CO5	Identify and solve problems involving random variables, probability distributions and Markov chains connected to digital signal processing, information code theory and structural engineering

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	0	0	0	0	0	0	0	2	1	0
CO2	3	2	2	1	0	0	0	0	0	0	0	2	2	0
CO3	3	3	2	2	2	0	0	0	0	0	0	2	2	1
CO4	3	3	3	2	2	0	0	0	0	0	1	3	2	1
CO5	3	3	2	2	2	0	0	0	0	0	1	2	3	1

Mapping of CO's with Knowledge and Attitude Profile (WK)										
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0										
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO1	2	3	2	1	0	0	0	1	0	
CO2	2	3	2	2	0	0	0	1	0	
CO3	1	3	2	2	1	1	0	2	0	
CO4	2	3	3	2	2	1	0	2	0	
CO5	1	3	2	2	1	1	0	2	0	

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Semester: IV

Scheme: 2025

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO2	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
CO3	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0
CO5	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0

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 School of Applied Science and Humanities
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B.E. (Lateral Entry: Common to all branches)

Semester: IV

Scheme: 2025

Course Title	BASIC ENGINEERING MATHEMATICS-I						
Course Code	IBMATDIP31						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	01	00	00	02	01	14+28=42	00
CIE Marks: 100			Total Max. Marks: 100				

Course Learning Objectives:
To develop a basic Mathematical knowledge required for higher semesters with few examples of its engineering applications.

SYLLABUS	No. of Hours	BTLs
UNIT 1	03	L1-L4
Differential Calculus: Recapitulation of the concept of differentiation, product rule, quotient rule, chain rule, successive differentiation, higher order derivatives, partial derivatives of first and second order.		
SELF-STUDY COMPONENTS: Differentiation of parametric functions, partial derivatives of second order.		
UNIT 2	02	L1-L4
Probability Theory: Definition of probability, addition theorem, multiplication theorem (only statement), Baye's theorem.		
SELF-STUDY COMPONENTS: Conditional probability, random variables.		
UNIT 3	03	L1-L4
Integral Calculus: Recapitulation of the concept of Integration, integration by parts, substitution, definite integrals, reduction formulae (only statement).		
SELF-STUDY COMPONENTS: Reduction formulae – problems.		
UNIT 4	02	L1-L4
Ordinary Differential Equations-I: Order, degree, formation, Solution of homogeneous, Linear and Exact differential equations and its reductions.		
SELF-STUDY COMPONENTS: Solution of differential equations - Variable-separable methods, nonlinear differential equations – Bernoulli.		
UNIT 5	04	L1-L4
Ordinary Differential Equations-II: Solutions of Linear differential equations of higher order with constant coefficients-inverse differential, operator method of undetermined coefficients.		
SELF-STUDY COMPONENTS: Method of variation of parameters, Cauchy's differential equations.		

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B.E. (Lateral Entry: Common to all branches)

Semester: IV

Scheme: 2025

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics (44th Edition), Khanna Publishers, New Delhi.
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill publications, New Delhi, 11th Reprint, 2010.

REFERENCE BOOKS:

- | | |
|---|--|
| 1 | Erwin Kreyszig, Advanced Engineering Mathematics (Latest Edition), Wiley Publishers, New Delhi. |
| 2 | H. C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi. |
| 3 | N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010. |
| 4 | V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East-West press, Reprint 2005. |
| 5 | D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005. |

Assessment Details of CIE

The weightage of Continuous Internal Evaluation (CIE):

The students have to obtain a minimum of 40% marks individually in CIE to pass.

CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE (Theory Test, Assignment and Group activity).

****Self-Study Component should be not included for CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE is 40%.
Theory	Weightage of CIE1 and CIE2 Tests or CIE3 + Assignment + Group Activity	100	40
TOTAL		100	40

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

CO1	Analyze the basic concepts of calculus like differentiation and integration
CO2	Develop the knowledge to formulate and solve first- order of differential equations arising in a variety of engineering applications
CO3	Apply the concepts of higher order differential equations arising in a variety of engineering applications
CO4	Apply the concepts in problem solving and relate the solutions to the various engineering streams
CO5	Use the skills in understanding Mathematical knowledge.

Mapping of CO's, PO's with PSO's

Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2										2	1	
CO2	3	2										2	1	
CO3	3	2										2	1	
CO4	3											2	1	
CO5	3											2	1	

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							
CO4	3	1							
CO5	3	1							

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3													
CO4				3													
CO5				3													

Dr. Ambedkar Institute of Technology, Bengaluru - 560056
 School of Applied Science and Humanities
Programme: Mathematics
B.E. (Lateral Entry: Common to all branches)

Semester: IV

Scheme: 2025

Course Title	BASIC ENGINEERING MATHEMATICS-II						
Course Code	1BMATDIP41						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	01	00	00	02	01	14+28=42	00
CIE Marks: 100			Total Max. Marks: 100				

Course Learning Objectives:
To develop a basic Mathematical knowledge required for higher semesters with few examples of its engineering applications.

SYLLABUS	No. of Hours	BTLs
UNIT 1	03	L1-L4
Linear Algebra: Introduction, Rank of a matrix by elementary row operations, consistency of system of linear equations. SELF-STUDY COMPONENTS: System of linear non homogeneous equations - Gauss elimination method and Gauss-Jordan method.		
UNIT 2	02	L1-L4
Complex functions: Recapitulation of the concept of complex numbers, complex functions involving two variables, differentiation of complex functions. SELF-STUDY COMPONENTS: Analytic functions, orthogonality and harmonic functions.		
UNIT 3	03	L1-L4
Vector calculus: Recapitulation of the concept of vectors, scalar point and vector point functions, gradient, divergence and curl, vector integration. SELF-STUDY COMPONENTS: Solenoidal and irrotational vector fields and scalar potential.		
UNIT 4	03	L1-L4
Beta and Gamma functions: Definitions, equivalent forms of Beta and Gamma functions (no derivations), standard relation in Beta and Gamma functions, simple problems. SELF-STUDY COMPONENTS: Duplication formula and problems.		
UNIT 5	03	L1-L4
Laplace transforms: Definitions, standard results, shifting property, multiplication by t^n , division by t (no derivations): simple problems. SELF-STUDY COMPONENTS: Unit-step function and unit impulse function.		

TEXT BOOKS:
1. B.S. Grewal, Higher Engineering Mathematics (44 th Edition), Khanna Publishers, New Delhi. 2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill publications, New Delhi, 11 th Reprint, 2010

Programme: Mathematics
B.E. (Lateral Entry: Common to all branches)

Semester: IV

Scheme: 2025

REFERENCE BOOKS:	
1	Erwin Kreyszig, Advanced Engineering Mathematics (Latest Edition), Wiley Publishers, New Delhi.
2	H. C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.
3	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4	V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East-West press, Reprint 2005.
5	D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Assessment Details of CIE			
The weightage of Continuous Internal Evaluation (CIE): The students have to obtain a minimum of 40% marks individually in CIE to pass. CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE (Theory Test, Assignment and Group activity). **Self-Study Component should be not included for CIE.			
CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3 + Assignment + Group Activity	100	40
TOTAL		100	40

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Analyze the basic concepts of calculus like differentiation and integration
CO2	Develop the knowledge to formulate and solve first- order of differential equations arising in a variety of engineering applications
CO3	Apply the concepts of higher order differential equations arising in a variety of engineering applications
CO4	Apply the concepts in problem solving and relate the solutions to the various engineering streams
CO5	Use the skills in understanding Mathematical knowledge

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2										2	1	3
CO2	3	2										2	1	3
CO3	3	2										2	1	3
CO4	3											2	1	3
CO5	3											2	1	3

Mapping of CO's with Knowledge and Attitude Profile (WK)									
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0									
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	2							
CO2	3	2							
CO3	3	2							
CO4	3	1							
CO5	3	1							

Semester: VI

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Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3													
CO2				3													
CO3				3													
CO4				3													
CO5				3													

Semester: VI

Scheme: 2025

Course Title	Numerical Methods for Engineering						
Course Code	1BMAE01						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	3	2	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:
This course is proposed to impart to the students the skills of employing numerical techniques, root-finding methods, interpolation formulas, numerical integration, matrix factorizations, finite difference methods, boundary value problems, partial differential equations, and optimization techniques to solve basic and complex engineering problems with related applications.

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Transcendental and Polynomial Equations: Fixed point iteration, Muller's method, Aitkin's method. Chebyshev method, Birge-Vita method, Multipoint iteration method, Bairstow's method.		
SELF-STUDY COMPONENTS: Graeffe's root squaring method.		
UNIT 2	10	L1-L4
Interpolation and Numerical Integration: Central Difference Interpolation: Stirling's Formula, Bessel's Formula, and Everett's formula. Numerical Integration: Romberg's method, Euler-Maclaurin formula, Gaussian Quadrature-Legendre and Chebyshev integration.		
SELF-STUDY COMPONENTS: Hermite interpolation, Cubic spline interpolation.		
UNIT 3	10	L1-L4
Numerical Linear Algebra: Direct Methods for Linear Systems: Introduction to Matrix Factorization, LU Decomposition Methods - Doolittle's Method, Crout's Method, Cholesky's Factorization Method. Iterative Methods for Linear Systems: Gauss-Jacobi Iteration Method, Gauss-Seidel Iteration Method, Successive Over-Relaxation (SOR) Method.		
SELF-STUDY COMPONENTS: QR decomposition, Power method for dominant eigenvalues.		
UNIT 4	10	L1-L4
Finite Difference Method: Finite difference approximations for derivatives, boundary value problems - Dirichlet's problem, Neumann problem and mixed boundary value problem.		
Numerical Solution of Partial Differential Equation: Classification of Second-Order Partial Differential Equations, Numerical Solution of Elliptic Equations - Laplace Equation and Poisson's Equation.		

Semester: VI

Scheme: 2025

SELF-STUDY COMPONENTS: Crank-Nicolson method, Wave equation.		
UNIT 5	10	L1-L4
Optimization Techniques: Transportation Problem: Initial Basic Feasible Solutions - North-West Corner Rule, Least Cost Method, Vogel's Approximation Method, Optimality Test - MODI Method, Stepping Stone Method. Assignment Problem: Hungarian Method and Unbalanced Assignment Problems.		
SELF-STUDY COMPONENTS: Travelling Salesman Problem, Degeneracy in Transportation problem.		

TEXT BOOKS:
1. M. K. Jain, S. R. K. Iyengar and R. K. Jain: Numerical Methods for Scientific and Engineering Computation, 7th Edition, New Age International Publishers, 2019. 2. B. S. Grewal: Higher Engineering Mathematics, 45th Edition, Khanna Publishers, 2021. 3. S. Arumugam - Algebra, New Gamma Publishing House 1994.

REFERENCE BOOKS:
1 B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Education..
2 Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press
3 C. Ray Wylie, Louis C. Barrett, Advanced Engineering Mathematics, McGraw Hill Book Co., New York
4 H.K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publication
e-LEARNING RESOURCES:
1 http://nptel.ac.in/courses.php?disciplineID=111
2 http://www.class-central.com/subject/math(MOOCs)
3 VTU e-Shikshana Program
4 VTU EDUSAT Program

Assessment Details both (CIE and SEE)			
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass. CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE. SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks. **Self-Study Component should be not included for SEE & CIE.			
CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	50	20
TOTAL		50	20

Semester: VI

Scheme: 2025

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

Course Outcomes: After the completion of the course, the student will be able to:	
CO1	Apply numerical techniques to solve algebraic, transcendental, and linear simultaneous equations using direct and iterative methods.
CO2	Demonstrate interpolation and numerical integration methods to approximate functions.
CO3	Analyze polynomial equations using root relations, transformations, and classical solution techniques.
CO4	Solve linear and simultaneous difference equations with constant coefficients and boundary value problems using finite difference methods.
CO5	Examine optimization techniques including transportation and assignment problems to find optimal solutions.

Mapping of CO's, PO's with PSO's														
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			2								2	1
CO2	3	2		2	3								2	2
CO3	3	3		2									2	2
CO4	3	3	2	2									2	2
CO5	3	3		2									2	2

Mapping of CO's with Knowledge and Attitude Profile (WK)										
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0										
CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO1	3	3	2							
CO2	3	3	2							
CO3	3	3	2							
CO4	3	3	2							
CO5	3	3	2							

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3					1								
CO2				3					1								
CO3				3					2								
CO4				3					2								
CO5				3					2								

Dr. Ambedkar Institute of Technology, Bengaluru – 560056
School of Applied Science and Humanities
Programme: Mathematics
(Common for All Branches)

Semester: VI

Scheme: 2025

Course Title	MATHEMATICAL COMPUTING FOR ARTIFICIAL INTELLIGENCE						
Course Code	1BMAE02						
Course Category	ASC (Applied Science Course)						
Teaching - Learning Scheme & Credit	L	T	P	S	Total	Total Teaching Hours	Credit
	03	02	0	4	5	42+28+50=120	4
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 03 Hrs	

Course Learning Objectives:

This course is designed to integrate advanced computational mathematics with modern Artificial Intelligence and Machine Learning techniques. The curriculum aims to develop the mathematical foundations, visual intuition, and programming skills required for high-dimensional data processing, model optimization, network analysis, and intelligent systems engineering.

SYLLABUS	No. of Hours	BTLs
UNIT 1	10	L1-L4
Eigen Structures, Matrix Transformations and Graph Spectra: Linear transformations, matrix spaces, eigen analysis, Matrix powers (A^k) and spectral radius ($\rho(A)$). Graph matrices (adjacency matrix A , degree matrix D , and the Graph Laplacian $L = D - A$), and fundamentals of spectral graph theory. Network clustering, image coordinate transformations, and recommendation systems.		
SELF-STUDY COMPONENTS: Spectral clustering algorithms and Laplacian properties.		
UNIT 2	10	L1-L4
Matrix Factorization and Dimensionality Reduction: Orthogonal matrices, symmetric matrices, quadratic forms, and definiteness classifications (positive/negative definite, indefinite). Singular Value Decomposition (SVD) of rectangular matrices: singular values, left-singular and right-singular vectors. Principal Component Analysis (PCA) derivation, low-rank matrix approximations, and algebraic feature extraction. Image compression, data compression, and pattern recognition.		
SELF-STUDY COMPONENTS: Latent semantic analysis and recommender systems.		
UNIT 3	10	L1-L4
Optimization for Machine Learning: Convex sets, convex functions, and mathematical optimization landscapes. Unconstrained optimization: stationary points, local and global extrema, and saddle points. Gradient Descent (GD) and Stochastic Gradient Descent (SGD) formulations. Regularization techniques (L1 and L2 penalties). Training machine learning models, engineering design optimization.		
SELF-STUDY COMPONENTS: Lagrange multipliers and constrained optimization.		
UNIT 4	10	L1-L4
Numerical Optimization and Computational Intelligence: Classification of optimization problems, gradients and Hessian matrices. Second-order optimization: Newton's Method for optimization, fixed-point iterations, and convergence analysis. Computational complexity of optimization algorithms. Introduction to computational intelligence and heuristic optimization techniques (Genetic Algorithms		

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and Particle Swarm Optimization). Engineering optimization, intelligent decision systems, and algorithmic parameter tuning.		
SELF-STUDY COMPONENTS: Evolutionary optimization algorithms and selection operators.		
UNIT 5	10	L1-L4
Network Science and Graph Analytics: Introduction to complex network theory, structural centrality measures (degree, eigenvector, closeness, and betweenness). Random walks on graphs, stationary distributions, and the PageRank algorithm. Community detection frameworks, graph clustering, and graph embeddings. Introduction to Graph Neural Networks (GNNs). Cybersecurity analytics, recommendation systems, web search engines, and social network analysis.		
SELF-STUDY COMPONENTS: Knowledge graphs and graph database architectures.		

TEXT BOOKS:
1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020. 2. Gilbert Strang, Linear Algebra and Learning from Data, Wellesley-Cambridge Press, 2019. 3. Singiresu S. Rao, Engineering Optimization: Theory and Practice, 5th Edition, John Wiley & Sons, 2019. 4. Andries P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, John Wiley & Sons, 2007. 5. Albert-László Barabási, Network Science, Cambridge University Press, 2016. 6. Charu C. Aggarwal, Artificial Intelligence: A Textbook, Springer, 2021. 7. Stephen Boyd and Lieven Vandenberghe, Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares, Cambridge University Press, 2018.

REFERENCE BOOKS:	
1	Stephen Boyd, Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2004.
2	Charu C. Aggarwal, Linear Algebra and Optimization for Machine Learning, Springer, 2020.
3	David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education, 2013.
4	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
e-LEARNING RESOURCES:	
1	https://nptel.ac.in/courses/111106051
2	https://nptel.ac.in/courses/106106179
3	VTU e-Shikshana Program
4	https://nptel.ac.in/courses/111106102

Assessment Details both (CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) and Semester End Exam (SEE) is 50% each. The students have to obtain a minimum of 40% marks individually both in CIE and SEE to pass.

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CIE: The CIE has three components – CIE - theory component, assignment and group activity. Students have to score a minimum of 40% Marks in the total of CIE - theory, assignment and group activity components put together to take SEE.

SEE: Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and reduced to 50 Marks.

****Self-Study Component should be not included for SEE & CIE.**

CONTINUOUS INTERNAL EVALUATION (CIE)		Max. Marks	Minimum Marks to be scored in CIE, to qualify to take SEE (40% individually)
Theory	Weightage of CIE1 and CIE2 Tests or CIE3	50	20
TOTAL		50	20

QUESTION PAPER PATTERN (SEE)

Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1	2	3	4	5					

1. Two full questions (each of 20 Marks) are to be set from each unit.

2. Student shall answer five full questions selecting one full question from each unit.

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

CO1	Apply concepts of linear transformations, eigen analysis, and graph spectral methods to model and solve computational engineering problems.
CO2	Analyze matrix factorization, quadratic forms, Singular Value Decomposition (SVD), and Principal Component Analysis (PCA) for dimensionality reduction and feature extraction.
CO3	Develop optimization models using Gradient Descent, Stochastic Gradient Descent, and regularization techniques for machine learning applications.
CO4	Estimate optimal solutions of engineering and AI problems using numerical optimization and computational intelligence techniques.
CO5	Examine complex networks using graph analytics, centrality measures, PageRank, community detection, and graph embeddings for intelligent systems.

Mapping of CO's, PO's with PSO's

Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	3							3	2	
CO2	3	3	2	2	3							3	3	
CO3	2	3	3	3	3							2	3	
CO4	2	3	3	3	3							2	3	
CO5	3	3	2	3	3							3	3	

Mapping of CO's with Knowledge and Attitude Profile (WK)

Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	3	3	2	1					
CO2	2	3	3	1					
CO3	2	3	3	2	1				

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CO4	2	2	2	3	1	1	1		
CO5	2	3	3	3	2	1	1	1	1

Mapping of CO's with Sustainable Development Goals (SDG)																	
Strength of correlation: Strongly related-3, Moderately related-2, Weakly related-1, Not related-0																	
CO/SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO1				3					2								
CO2				3					2								
CO3				3					3								
CO4				3					3								
CO5				3					3								

Heads of Programme

Dr. Shivaprasanna G S
Associate Professor
Mathematics

Head of School

Dr. Jambunath S. Baligar
Professor
School of Basic Sciences
and Humanities, Dr. A.I.T