16-2-2023

II Semester

Course Title:	**Mathematics-II for Electrical & Electronics Engineering Stream**		
Course Code:	**BMATE201**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 10 to12 Lab slots	Credits	04

Course objectives: The goal of the course**Mathematics-II for Electrical & Electronics Engineering Stream(22MATE21)** is to

- **Familiarize** the importance of Vector calculus, Vector Space and Linear transformation for electronics and electrical engineering.
- **Have an insight** into solving ordinary differential equations by using Laplace transform techniques.
- **Develop** the knowledge of solving electronics and electrical engineering problems numerically.

Teaching-Learning Process

Pedagogy (General Instructions):

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

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1:Vector Calculus (8 hours)

Introduction to Vector Calculus in EC & EE engineering applications.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.

Self-Study: Volume integral and Gauss divergence theorem.

Applications: Conservation of laws, Electrostatics, Analysis of streamlines and electric potentials.

(RBT Levels: L1, L2 and L3)

Module-2:Vector Space and Linear Transformations(8 hours)

Importance of Vector Space and Linear Transformations in the field of EC & EE engineering applications.

Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension.

Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, Rank-Nullity theorem. Inner product spaces and orthogonality.

Self-study: Angles and Projections.Rotation, reflection, contraction and expansion.

Applications: Image processing, AI & ML, Graphs and networks, Computer graphics.

(RBT Levels: L1, L2 and L3)

Module-3:Laplace Transform(8 hours)

Importance of Laplace Transform for EC & EE engineering applications.

Existence and Uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence. Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the s-domain, division by t, differentiation and integration in the time domain. LT of special functions-periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function.

Inverse Laplace Transforms:

Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and applications to solve ordinary differential equations.

Self-Study: Verification of convolution theorem.

Applications: Signals and systems, Control systems, LR, CR & LCR circuits.

(RBT Levels: L1, L2 and L3)

Module-4:Numerical Methods -1(8 hours)

Importance of numerical methods for discrete data in the field of EC & EE engineering applications.

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

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

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

Self-Study: Bisection method, Lagrange's inverse Interpolation, Weddle's rule.

Applications: Estimating the approximate roots, extremum values, area, volume, and surface area.
(RBT Levels: L1, L2 and L3)

Module-5:Numerical Methods -2(8 hours)

Introduction to various numerical techniques for handling EC & EE applications.
Numerical Solution of Ordinary Differential Equations (ODEs):
Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.
Applications: Estimating the approximate solutions of ODE for electric circuits.
(RBT Levels: L1, L2 and L3)

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

1	Finding gradient, divergent, curl and their geometrical interpretation and Verification of Green's theorem
2	Computation of basis and dimension for a vector space and Graphical representation of linear transformation
3	Visualization in time and frequency domain of standard functions
4	Computing inverse Laplace transform of standard functions
5	Laplace transform of convolution of two functions
6	Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method
7	Interpolation/Extrapolation using Newton's forward and backward difference formula
8	Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4^{th} order and Milne's predictor-corrector method

Suggested software's: Mathematica/MatLab/Python/Scilab

Course outcome (Course Skill Set)
At the end of the course the student will be able to:

CO1	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, lineintegral and surface integral.
CO2	Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation
CO3	To understand the concept of Laplace transform and to solve initial value problems.
CO4	Apply the knowledge of numerical methods in solving physical and engineering phenomena.
CO5	Get familiarize with modern mathematical tools namely MATHEMATICA/MATLAB/PYTHON/ SCILAB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks.**

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (**duration 03 hours)** at the end of the 15^{th} week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is

to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

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

Text Books

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

Reference Books

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

Web links and Video Lectures (e-Resources):

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

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

COs and POs Mapping (Individual teacher has to fill up)

COs	POs						
	1	2	3	4	5	6	7
CO1							
CO2							
CO3							
CO4							
CO5							

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

BLOW UP SYLLABUS

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Second Semester B.E

Mathematics-II for Electrical & Electronics Engineering Stream (22MATE21)

(Effective from the academic year 2022 – 23)

Topics	Topics To Be Covered	Hours
MODULE 1: VECTOR CALCULUS		
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence- physical interpretation, Solenoidal and irrotational vector fields. Problems.	Discussion restricted to problems in Articles No. 8.4, 8.5, 8.6, 8.7 of Textbook 1.	2L
Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.	Discussion of Problems in Articles No. 8.11, 8.12, 8.13 and 8.14 of Textbook 1.	2L
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module-Conservation of laws, Electrostatics, Streamlines-Streaklines and Electric potentials.** iii) Guidance to the students for self-study topics through illustrative examples.	4T
Self-Study: Volume Integral and Gauss Divergence theorem	**Article No. 8.15, 8.16 of Textbook 1.** 1. **No question is said to be set for SEE** 2. **20% weightage shall be given to CIE from self-study topics.**	
(RBT LEVEL: L1, L2, L3)	**Total**	**8 Hours**
MODULE-2: VECTOR SPACES AND LINEAR TRANSFORMATIONS		
Vector spaces: definition and examples, subspace, linear span, linearly independent and dependent sets, basis and dimensions.	Discussion restricted to problems in Articles No. 4.1 to 4.5 of Textbook 3.	2L
Linear Transformations: Definition and examples, algebra of transformations, matrix of a linear transformation, change of coordinates, Rank and Nullity of a linear operator, Rank – Nullity Theorem. Inner Product spaces and orthogonality.	Discussion of Problems in Article No. 1.7,1.8, 1.9, 4.6, 4.7 and 6.1 of Textbook 3.	2L
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module-Image processing, AI/ML, Graphs and networks, and Computer graphics.** iii) Guidance to the students for self-study topics through illustrative examples.	4T
Self-study: Angles and projections, rotation, reflection, contraction and expansion	**Related articles in Textbook 3** 1. **No Question to be set for SEE** 2. **20% weightage shall be given to CIE from self-study topics**	

	Total	**8 hours**
(RBT Levels: L1, L2 & L3)		
MODULE-3: LAPLACE TRANSFORMS		
Existence and Uniqueness of Laplace transforms, Transform of elementary functions, region of convergence, properties–linearity, scaling, t-shifting property, s-domain shift, differentiation in the s domain, division by t, differentiation and integration in the time domain,	Article Nos. 6.1, 6.2, 6.3 of Textbook 2. Discussion of problems in Article No 21.1, 21.2, 21.3, 21.4, 21.7, 21.8, 21.9 and 21.10 of Textbook 1.	**2L**
LT of special functions – periodic functions (square wave, Sawtooth wave, triangular wave, full and half wave rectifier). Heaviside unit step function, Unit impulse function,	Article numbers 6.3, 6.4 of Textbook 2. Discussion of problems in Article No. 21.5. 21.17 and 21.18 of Textbook 1.	**1L**
Inverse Laplace transforms, Definitions, properties, evaluation using different methods, convolution theorem(without proof), problems, and applications to solve Ordinary differential equations.	Article No. 6.5 & 6.6 of Textbook 2. Discussion of problems in Article No 21.12, 21.13, 21.14, 21.15 example 21.34 of Textbook 1.	**1L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module-Signals and systems, Control systems, LR, CR and LCR circuits.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-Study: Verification of convolution theorem	**Article no. 21.14 of Textbook 1** 1. **No Question to be set for SEE** 2. **20%weightage shall be given to CIE from self-study topics**	
RBT Levels: L1, L2 and L3	**Total**	**8 hours**
MODULE-4: NUMERICAL METHODS-1		
Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.	Discussion of problems in Article No.28.2 (2) &28.2(3) of Textbook 1.	**1L**
Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.	Discussion of problems in Article No. 29.6, 29.10, 29.11, 29.12 of Textbook 1.	**2L**
Numerical Integration: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems.	Discussion of problems in Articles 30.6, 30.7and 30.8 of Textbook 1.	**1L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module-Estimating the approximate roots, Extreme values, Area, Volume, and Surface area.** iii) Guidance to the students for self-study	**4T**

Self-Study: Bisection method, Lagrange's inverse interpolation, Weddle's rule.	**Article No. 28.2, 29.13, 30.10 of Textbook 1** 1. **No question is said to be set for SEE** 2. **20% weightage shall be given to CIE from self-study topics**	
RBT Levels: L1, L2 and L3	**Total**	**8 hours**
MODULE 5: NUMERICAL METHODS-2		
Numerical Solution of Ordinary Differential Equations (ODEs) of first order and first degree: Taylor's series method, Modified Euler's method; Runge-Kutta method of fourth order. Milne's predictor-corrector formula (No derivations of formulae). Problems.	Discussion and problems restricted to Article No.32.3, 32.5, 32.7 &32.9 of Textbook 1.	**3L** **1L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module- Approximate solutions of ODE related to electrical and electronics engineering problems.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-Study: Adam-Bashforth method.	**Article 32.10 of Textbook 1** 1. **No Question to be set for SEE** 2. **20%weightage shall be given to CIE from self-study topics**	
RBT Levels: L1, L2 and L3	**Total**	**8 hours**
	topics through illustrative examples.	

Textbooks:

1. **B.S. Grewal:** "Higher Engineering Mathematics", Khanna Publishers, 43rd Ed., 2015.
2. **E. Kreyszig:** "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.
3. **David C Lay:** "Linear Algebra and its Application", 4th Ed., Pearson Publishers, 2018.

Reference Books:

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematics for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
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7. **James Stewart:** "Calculus" Cengage Publications, 7thEd., 2019.
8. **R K Jain and SRK Iyengar:** "Advanced Engineering Mathematics", 3rd edition, Narosa Publishers, 2007.
9. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.

Model Question Paper-I with effect from 2022 (CBCS Scheme)

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Second Semester B.E Degree Examination

Mathematics-II for Electrical & Electronics Engineering-BMATE201

TIME: 03 Hours | Max. Marks: 100

Note:
1. Answer any **FIVE** full questions, choosing at least **ONE** question from each **module.**
2. VTU Formula Hand Book is permitted.
3. M: Marks, L: Bloom's level, C: Course outcomes.

			M	L	C
		Module -1			
Q.01	a	Find the directional derivatives of $\emptyset = x^2yz + 4xz^2$ at $(1, 2, -1)$ along $2i - j - 2k$.	7	L2	CO1
	b	Evaluate $Curl(Curl\vec{F})$ and $Div(Curl\vec{F})$, if $\vec{F} = x^2y\,\hat{\imath} + y^2z\,\hat{\jmath} + z^2x\,\hat{k}$.	7	L2	CO1
	c	Show that the vector $\vec{F} = \frac{x\hat{\imath}+y\hat{\jmath}}{x^2+y^2}$ is both solenoidal and irrotational.	6	L3	CO1
		OR			
Q.02	a	Find the total work done by the force $F = 3xyI - yJ + 2zxK$ in moving a particle around the circle $x^2 + y^2 = 4$.	7	L3	CO1
	b	Verify Stoke's theorem for the vector field $\boldsymbol{F} = (2x - y)\boldsymbol{I} - yz^2\boldsymbol{J} - y^2z\boldsymbol{K}$ over the upper half surface of $x^2 + y^2 + z^2 = 1$, bounded by its projection on the xy- plane.	7	L2	CO1
	c	Using modern mathematical tools, write a code to find the divergence and curl of the vector $2x^2i - 3yzj + xz^2k$	6	L3	CO5
		Module-2			
Q. 03	a	Prove that in $V_3(R)$, the vectors $\{(1, 2, 1), (2, 1, 0), (1, -1, 2)\}$ are linearly independent.	7	L2	CO2
	b	If W is the set of all points in R^3 satisfying the equation $lx + my + nz = 0$, then prove that W is a subspace of R^3.	7	L2	CO2
	c	Define an Inner product space. Consider $f(t) = 3t - 5$ and $g(t) = t^2$, the inner product $< f, g > = \int_0^1 f(t)g(t)dt$. Find $< f, g >$.	6	L2	CO2
		OR			
Q.04	a	Express the vector (3, 5, 2) as a linear combination of the vectors (1, 1, 0), (2, 3, 0), (0, 0, 1) of $V_3(R)$.	7	L2	CO2
	b	Find the dimension and basis of the subspace spanned by the vectors (2, 4, 2), (1, -1, 0), (1, 2, 1), and (0, 3, 1) in $V_3(R)$.	7	L2	CO2
	c	Let $T: V \to W$ be a linear transformation defined by $T(x, y, z) = (x + y, x - y, 2x + z)$. Find the range, null space, rank, nullity and hence verify the rank-nullity theorem.	6	L2	CO2

		Module-3			
Q. 05	a	Find the Laplace transform of (i) $te^{-t}sin4t$ (ii) $\frac{1-cosat}{t}$	7	L2	CO3
	b	Find the Laplace transform of the square wave function of period 2a, defined by $f(t) = \begin{cases} k, & 0 < t < a \\ -k, & a < t < 2a \end{cases}$	7	L3	CO3
	c	Express $f(t) = \begin{cases} cost, & 0 < t < \pi \\ cos2t, & \pi < t < 2\pi \\ cos3t, & t > 2\pi \end{cases}$ in terms of the Heaviside unit step function and hence find $L\{f(t)\}$.	6	L3	CO3
		OR			
Q. 06	a	Find $L^{-1}\left\{\frac{2s^2-6s+5}{s^3-6s^2+11s-6}\right\}$	7	L2	CO3
	b	Find $L^{-1}\left\{\frac{1}{s^3(s^2+1)}\right\}$ Using the convolution theorem.	7	L2	CO3
	c	Solve by Laplace transform method: $y'' + 4y' + 3y = e^{-t}$, given $y(0) = y'(0) = 1$.	6	L3	CO3
		Module-4			
Q. 07	a	Find the real root of the equation $x\log_{10}x = 1.2$ by the Regula-Falsi method between 2 and 3 (Three iterations).	7	L2	CO4
	b	Using Newton's forward difference formula, find $f(38)$ x: 40, 50, 60, 70, 80, 90 y: 184, 204, 226, 250, 276, 304	7	L3	CO4
	c	The following table gives the values of x and y x: 2.8, 4.1, 4.9, 6.2 y: 9.8, 13.4, 15.5, 19.6 Find y when x = 8 using Lagrange's interpolation formula.	6	L2	CO4
		OR			
Q. 08	a	Using Newton-Raphson Method find the real root of $tanx = x$ near x = 4.5 correct to four decimal places.	7	L3	CO4
	b	Find the interpolating polynomial using Newton's divided difference formula for the following data x: 0, 1, 2, 5 y: 2, 3, 12, 147	7	L2	CO4

	c	Evaluate $\int_4^{5.2} \log x \, dx$ using Simpson's $\left(\frac{3}{8}\right)^{th}$ rule , taking h = 0.2	6	L3	CO4
		Module-5			
Q. 09	a	Use Taylor series method to find $y(0.2)$ by considering the terms up to 4th degree, given $\frac{dy}{dx} - 2y = 3e^x$ & $y(0) = 0$.	7	L3	CO4
	b	Given $\frac{dy}{dx} = 3x + \frac{y}{2}, y(0) = 1$. Compute $y(0.2)$ by taking $h = 0.2$ using Runge-Kutta method of fourth order.	7	L2	CO4
	c	Apply Milne's method to find $y(0.8)$ given $\frac{dy}{dx} + xy^2 = 0$ x: 0, 0.2, 0.4, 0.6 y: 2, 1.9231, 1.7214, 1.4706	6	L2	CO4
		OR			
Q. 10	a	Using Modified Euler's method to find y at $x = 0.2$ given $\frac{dy}{dx} = x - y^2$ & $y(0) = 1$ by taking step size h = 0.1	7	L3	CO4
	b	Find $y(2)$ by using Milne's Predictor and Corrector method, given $\frac{dy}{dx} = \frac{x+y}{2}$ and x: 0, 0.5, 1, 1.5 y: 2, 2.636, 3.595, 4.968	7	L2	CO4
	c	Using modern mathematical tools, write a code to find $y(0.1)$, given $\frac{dy}{dx} = x - y, y(0) = 1$ by Taylor's Series.	6	L3	CO5

Bloom's Taxonomy Levels	Lower-order thinking skills		
	Remembering (knowledge): L_1	Understanding (Comprehension): L_2	Applying (Application): L_3
	Higher-order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6

Model Question Paper-II with effect from 2022 (CBCS Scheme)

USN | | | | | | | | | | |

Second Semester B.E Degree Examination

Mathematics-II for ELECTRICAL &ELECTRONICS ENGINEERING Stream-BMATE201

TIME: 03 Hours Max. Marks: 100

Note:
1. Answer any **FIVE** full questions, choosing at least **ONE** question from each **module.**
2. VTU Formula Hand Book is permitted.
3. M: Marks, L: Bloom's level, C: Course outcomes.

		Module -1	M	L	C
Q.01	a	Find the angle between the surfaces $xy^2z = 3x + z^2$ and $3x^2 - y^2 + 2z = 1$ at the point $(1, -2, 1)$	7	L3	CO1
	b	Find $div\ \vec{F}$ and $curl\ \vec{F}$ at (1,2,3), if $\vec{F} = 3x^2\hat{\imath} + 5xy^2\hat{\jmath} + 5xyz^3\hat{k}$	7	L2	CO1
	c	Show that $\vec{A} = (y^2 - z^2 + 3yz - 2x)\hat{\imath} + (3xz + 2xy)\hat{\jmath} + (3xy - 2xz + 2z)\hat{k}$ is both solenoidal and irrotational	6	L2	CO1
		OR			
Q.02	a	Find the work done in moving a particle in the force field $\vec{F} = 3x^2\hat{\imath} + (2xz - y)\hat{\jmath} + z\hat{k}$ along the straight line from $(0, 0, 0)$ to $(2, 1, 3)$	7	L2	CO1
	b	Using Green's theorem evaluate $\oint(xy + y^2)dx + x^2dy$ over the region bounded by the curves $y = x$ and $y = x^2$	7	L3	CO1
	c	Using modern mathematical tools, write the code to find the gradient of $\phi = x^2y + 2xz - 4$	6	L3	CO5
		Module-2			
Q. 03	a	Define a subspace. Show that the intersection of two subspaces of a vector space V is also a subspace of V.	7	L2	CO2
	b	Define a basis for a vector space. Determine whether or not the vectors: $(1, 1, 2), (1, 2, 5), (5, 3, 4)$ form a basis of R^3.	7	L2	CO2
	c	Prove that $T: R^3 \rightarrow R^3$ be defined by $T(a, b, c) = (3a, a - b, 2a + b + c)$ is a linear transformation.	6	L2	CO2
		OR			
Q.04	a	Define linearly independent set of vectors and linearly dependent set of vectors. Are the vectors $V_1 = (2, 5, 3)$, $V_2 = (1, 1, 1)$, and $V_3 = (4, -2, 0)$ linearly independent? Justify your answer.	7	L2	CO2

	b	State the rank-Nullity theorem and verify the theorem for the linear transformation $T: R^3 \to R^3$ defined by $T(x, y, z) = (x + 2y - z,\ y + z,\ x + y - 2z)$.	7	L2	CO2
	c	Using the modern mathematical tool, write the code to represent the reflection transformation $T: R^2 \to R^2$ and to find the image of vector (10, 0) when it is reflected about the y-axis.	6	L3	CO5
		Module-3			
Q. 05	a	Find the Laplace transform of (i) $e^{-3t}(2\cos 5t - 3\sin 5t)$ (ii) $\frac{\cos at - \cos bt}{t}$	7	L2	CO3
	b	Find the Laplace transform of the triangular wave function $f(t) = \begin{cases} t & if\ 0 \le t \le a \\ 2a - t & if\ a \le t \le 2a \end{cases}$	7	L2	CO3
	c	Express the following function in terms of unit step function and hence find its Laplace transform of $f(t) = \begin{cases} t^2, & 0 < t < 2 \\ 4t, & 2 < t < 4 \\ 8, & t > 4 \end{cases}$	6	L3	CO3
		OR			
Q. 06	a	Find the inverse Laplace transform of (i) $\frac{s}{s^2+2s+3}$ (ii) $\frac{1}{(s+2)^2}$	7	L2	CO3
	b	Using the convolution theorem, find the inverse Laplace transform of $\frac{s}{(s^2 + a^2)^2}$	7	L3	CO3
	c	Solve the differential equation by using the Laplace transform method $\frac{d^2y}{dt^2} + y = \sin 2t,\ y(0) = 0, y'(0) = 0$	6	L3	CO3
		Module-4			
Q. 07	a	By Newton-Raphson method, find the root of $x \tan x + 1 = 0$ which is near to $x = \pi$	7	L2	CO4
	b	Using Lagrange's interpolation formula, fit a polynomial which passes through the points (−1, 0), (1, 2), (2, 9) and (3, 8) and hence estimate the value of y when $x = 2.2$	7	L2	CO4
	c	Evaluate $\int_0^6 \frac{e^x}{1+x}\, dx$ using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking 7 ordinates	6	L3	CO4
		OR			
Q. 08	a	Find a real root of the equation $x^3 - 4x - 9 = 0$ correct to three decimal places by the method of false position in (2, 3)	7	L2	CO4

	b	Construct Newton's forward interpolation polynomial for the data x: 4, 6, 8, 10 $f(x)$: 1, 3, 8, 16	7	L2	CO4
	c	Evaluate $\int_0^3 \frac{x}{\cos x} dx$ by using Simpson's $\left(\frac{3}{8}\right)^{th}$ rule, by taking 6 equal intervals. (x is in radians)	6	L2	CO4
		Module-5			
Q. 09	a	Use Taylor series method to find $y(0.1)$ from $\frac{dy}{dx} = e^x - y^2, with\ y(0) = 1$	7	L2	CO4
	b	Using the Runge-Kutta method of order 4, find y at x = 0.6, given that $\frac{dy}{dx} = \sqrt{x+y}$, $y(0.4) = 0.41$ taking $h = 0.2$	7	L2	CO4
	c	Applying Milne's Predictor-Corrector method, find y(0.8), from $\frac{dy}{dx} = x^3 + y$, given that $y(0) = 2$, $y(0.2) = 2.073$, $y(0.4) = 2.452$, $y(0.6) = 3.023$	6	L2	CO4
		OR			
Q. 10	a	Solve by Using Modified Euler's method, $y' = \log_{10}(x+y)$, $y(0) = 2$ at $x = 0.2$ and $x = 0.4$	7	L3	CO4
	b	Using the Runge-Kutta method of fourth order find y(0.1) given that $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$, taking $h = 0.1$	7	L3	CO4
	c	Using modern Mathematical tools, write the code to find the solution of $\frac{dy}{dx} = x - y^2$ at y(0.1). Given that y(0) = 1 by Runge-Kutta 4th order method.	6	L3	CO5

Bloom's Taxonomy Levels	**Lower-order thinking skills**		
	Remembering (knowledge): L_1	Understanding (Comprehension): L_2	Applying (Application): L_3
	Higher-order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6

CBCS SCHEME

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, June/July 2023
Mathematics – II for EEE Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Find the angle between the direction to the normals to the surface $x^2yz = 1$ at the point (-1, 1, 1) and (1, -1, -1).	7	L1	CO1
	b.	If $\vec{F} = \text{grad}(xy^3z^2)$ find $\text{div}\vec{F}$ and $\text{curl}\vec{F}$ at the point (1, -1, 1).	7	L2	CO1
	c.	Find the divergence and curl of the vector $\vec{V} = (xyz)\hat{i} + (3x^2y)\hat{j} + (xz^2 - y^2z)\hat{k}$ at the point (2, -1, 1)	6	L1	CO1
		OR			
Q.2	a.	Using Green's theorem evaluate $\int_C (y - \sin x)dx + \cos x dy$ where C is the plane triangle enclosed by the lines $y = 0$, $x = \frac{\pi}{2}$ and $y = \frac{2}{\pi}x$.	7	L3	CO1
	b.	Use stoke's theorem for vector $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken around the rectangle bounded by $x = 0$, $x = a$, $y = 0$, $y = b$.	7	L3	CO1
	c.	Using modern mathematical tools, write the code to find the gradient of $\phi = x^2y + 2xz - 4$.	6	L3	CO5
		Module – 2			
Q.3	a.	Define a subspace. Show that the intersection of any two subspaces of a vector space V is also a subspace of V.	7	L2	CO2
	b.	Show that the set B = {(1, 1, 0) (1, 0, 1) (0, 1, 1)} is a basis of the vector space $V_3(R)$.	7	L3	CO2
	c.	Prove that $T : R^2 \to R^3$ be defined by T(a, b) = (a+b, a-b, b) is a linear transform.	6	L3	CO2
		OR			
Q.4	a.	Show that the set S = {(1, 0, 1) (1, 1, 0) (−1,0,−1) } is linearly dependent in $V_3(R)$.	7	L3	CO2
	b.	Let $T : R^3 \to R^3$ defined by T(x, y, z) = (x+y, x-y, 2x+z). Find the rank and nullity of T and verify rank of T + nullity of T = $\dim(R^3)$.	7	L2	CO2
	c.	Using the modern mathematical tool, write the code to find the dimension of subspace spanned by the vectors (1, 2, 3) (2, 3, 1) and (3, 1, 2)	6	L3	CO5

		Module – 3			
Q.5	**a.**	Find the Laplace transform of, (i) $e^{-4t}(2\cos 6t - 3\sin 5t)$ (ii) $\dfrac{\cos 2t - \cos 3t}{t}$	**7**	**L1**	**CO3**
	b.	Find the Laplace transform of a square wave function, $f(t) = \begin{cases} E & 0 \le t \le \dfrac{T}{2} \\ -E & \dfrac{T}{2} \le t \le T \end{cases}$ Show that $L\{f(t)\} = \dfrac{E}{S}\tanh\left(\dfrac{ST}{4}\right)$.	**7**	**L2**	**CO3**
	c.	Express $f(t) = \begin{cases} \sin t & 0 < t < \pi \\ \sin 2t & \pi < t < 2\pi \\ \sin 3t & t \ge 2\pi \end{cases}$ in terms of unit step function and hence find $L\{f(t)\}$.	**6**	**L3**	**CO3**
		OR			
Q.6	**a.**	Find $L^{-1}\left[\dfrac{1}{s(s+1)(s+2)(s+3)}\right]$.	**7**	**L1**	**CO3**
	b.	Find $L^{-1}\left[\dfrac{s}{(s^2+a^2)^2}\right]$ using convolution theorem.	**7**	**L3**	**CO3**
	c.	Solve by Laplace transform method $y'' + 4y' + 4y = e^{-t}$ with $y(0) = y'(0) = 0$	**6**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Find the real root of the equation $x\log_{10} x = 1.2$ by using the Regula-Falsi method between 2 and 3 (three iterations).	**7**	**L1**	**CO4**
	b.	Given $\sin 45^\circ = 0.7071$, $\sin 50^\circ = 0.7660$, $\sin 55^\circ = 0.8192$, $\sin 60^\circ = 0.8660$, find $\sin 52^\circ$ using Newton's forward interpolation formula.	**7**	**L3**	**CO4**
	c.	Using Lagrange's interpolation formulae to find f(5) from the following data: x: 1, 3, 4, 6, 9 f(x): -3, 9, 30, 132, 156	**6**	**L3**	**CO4**
		OR			
Q.8	**a.**	Find the real root of the equation, $x\tan x + 1 = 0$ which is near to $x = \pi$ by using Newton-Raphson method.	**7**	**L2**	**CO4**
	b.	Using Newton's divided difference formulae and find f(4) given the data : x: 0, 2, 3, 6 f(x): -4, 2, 14, 158	**7**	**L3**	**CO4**
	c.	Evaluate $\int_0^{0.6} e^{-x^2}\,dx$ by using Simpson's $\left(\dfrac{1}{3}\right)^{rd}$ rule by taking seven ordinates.	**6**	**L5**	**CO4**

Module – 5

Q.9	**a.**	Solve $\frac{dy}{dx} = e^x - y$, $y(0) = 2$ by using Taylor's method upto 4^{th} degree terms and find the value of $y(1.1)$.	**7**	**L3**	**CO4**
	b.	Using the Runge-Kutta method of order 4 find y at $x = 0.1$ given that $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ and $h = 0.1$	**7**	**L3**	**CO4**
	c.	Apply Milne's predictor corrector method, find $y(0.4)$ from $\frac{dy}{dx} = 2e^x y$	**6**	**L2**	**CO4**

x	0	0.1	0.2	0.3
y	2.4	2.473	3.129	4.059

OR

Q.10	**a.**	Solve by using modified Euler's method $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0) = 1$ at $x = 0.2$.	**7**	**L3**	**CO4**
	b.	Using the Runge-Kutta method of 4^{th} order find $y(0.2)$ given that $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.2$.	**7**	**L3**	**CO4**
	c.	Using modern mathematical tools write the code to find the solution of $\frac{dy}{dx} = x - y^2$ at $y(0.1)$. Given that $y(0) = 1$ by Runge Kutta 4^{th} order.	**6**	**L2**	**CO5**

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MAKE-UP EXAM

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BMATE201

Second Semester B.E/B.Tech. Degree Examination, Nov./Dec. 2023

Mathematics - II for EEE Stream

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU formula hand book is permitted.

		Module – 1	M	L	C
1	a.	If $\phi = x^2 + y - z - 1$ find grad ϕ at (1, 0, 0). Also find its magnitude.	6	L3	CO1
	b.	Find the divergence and curl of the vector : $\vec{F} = (xyz)\hat{i} + (3x^2y)\hat{j} + (xz^2 - y^2z)\hat{k}$ at (2, –1, 1).	7	L2	CO1
	c.	Show that $\vec{F} = (y^2 - z^2 + 3yz - 2x)\hat{i} + (3xz + 2xy)\hat{j} + (3xy - 2xz + 2z)\hat{k}$ is both solenoidal and irrotational.	7	L2	CO1
		OR			
2	a.	Suppose $\vec{F} = x^3\hat{i} + y\hat{j} + z\hat{k}$ is the force field. Find the work done by $\vec{F}$ along the line from (1, 2, 3) to (3, 5, 7).	6	L2	CO1
	b.	Verify Green's theorem in the xy – plane for $\int_C (xy + y^2)dx + x^2dy$, where C is the closed curve of the region bounded by $y = x$ and $y = x^2$.	7	L3	CO1
	c.	Using modern mathematical tools, write the code to find the divergence of $\vec{F} = x^2y\hat{i} + yz^2\hat{j} + x^2z\hat{k}$.	7	L3	CO5
		Module – 2			
3	a.	Define a subspace. Show that a subset $S = \{x_1, x_2, x_3 \mid x_1 + x_2 + x_3 = 0\}$ of $V_3(R)$ is a subspace of $V_3(R)$.	6	L2	CO2
	b.	Prove that in $V_3(R)$ the vectors {(1, 2, 1) (3, 1, 5), (3,–4, 7)} are linearly independent.	7	L2	CO2
	c.	Find $\langle p, q \rangle$ and $\|\|P\|\|$. Given $P(x) = x^2 - x$, $q(x) = x + 1$, the innerproduct space $\langle p, q \rangle = \int_{-1}^{1} P(x); q(x)dx$.	7	L2	CO2

		OR			
4	a.	Let $T : U \to V$ be a linear transformation defined by, $T(x, y, z) = \{(x + y, x - y, 2x + z)/x, y, z, \in R)$. Verify Rank Nullity theorem.	6	L2	CO2
	b.	Explain the vector $(2, -5, -1)$ as a linear combination of the vectors $(1, 2, 3)(2, 1, 1)(1, 3, 2)$ of $V_3(R)$.	7	L2	CO2
	c.	Using the modern mathematical tool write the code to represent the reflection transformation $T : R^2 \to R^2$ and to find the image of vector $(10, 0)$ when it reflected about the y – axis.	7	L3	CO5
		Module – 3			
5	a.	Find the Laplace transform of $\left(\frac{\sin 2t}{\sqrt{t}}\right)^2$.	6	L2	CO3
	b.	Find $L^{-1}\left\{\frac{1}{s(s^2+1)}\right\}$ using convolution theorem.	7	L2	CO3
	c.	Express $f(t) = \begin{cases} \cos t & 0 < t < \pi \\ \cos 2t & \pi < t < 2\pi \\ \cos 3t & t > 2\pi \end{cases}$ interms of unit step function and find $L\{f(t)\}$.	7	L3	CO3
		OR			
6	a.	Find the inverse Laplace transform of i) $\frac{(s+2)^3}{s^6}$ ii) $\frac{2s+5}{4s^2+25}$.	6	L2	CO3
	b.	Solve by Laplace transform method : $y'' + 4y' + 3y = e^{-t}$; $y(0) = 1 = y'(0)$.	7	L2	CO3
	c.	Find the Laplace transform of the square wave function of period a, defined by $f(t) = \begin{cases} K & 0 < t < a/2 \\ -K & a/2 < t < a \end{cases}$.	7	L2	CO3
		Module – 4			
7	a.	Evaluate $\int_2^7 \left(\frac{1}{x}\right) dx$, using Trapezodial rule, taking $n = 5$.	6	L3	CO4
	b.	Find the real toot of the equation $e^x - 3x - \sin x = 0$ by the Regula – Falsi method between 0 and 1. (carry out three iterations) x is in radians.	7	L2	CO4
	c.	Find y at $x = 1$ using Newton divided difference formula for the following data : x: 0, 2, 3, 4, 7, 9 y: 4, 26, 58, 112, 466, 922	7	L2	CO4

OR

8	**a.**	Evaluate : $\int_{2}^{\pi/2} \cos x \, dx$, using Simpson's $(1/3)^{rd}$ rule with $n = 8$ [x in radian].	**6**	**L3**	**CO4**
	b.	Construct Newton's forward interpolation polynomial for the data : x: 0, 1, 2, 3, 4 f(x): 3, 6, 11, 18, 27	**7**	**L2**	**CO4**
	c.	Find y when x = 10 for the following data by using Kagrange's interpolation formula : x: 5, 6, 9, 11 y: 12, 13, 14, 16	**7**	**L2**	**CO4**

Module – 5

9	**a.**	Using Taylor's method to find y(0.2) by considering the terms upto 4^{th} degree, given $\frac{dy}{dx} - 2y - 3e^x = 0$; $y(0) = 0$.	**6**	**L3**	**CO4**
	b.	Given $\frac{dy}{dx} = x + y$; $y(0) = 1$. Compute y(0.2) using Runge – Kutta 4^{th} order method [h = 0.2].	**7**	**L2**	**CO4**
	c.	Apply Milne's predictor and corrector method find y at x = 2 given $\frac{dy}{dx} = \frac{2y}{x} (x \neq 0)$ x: 1, 1.25, 1.5, 1.75 y: 2, 3.13, 4.5, 6.13	**7**	**L2**	**CO4**

OR

10	**a.**	Using Modified Euler's method to find y at x = 0.2 given $y' = \frac{x - y}{2}$; $y(0) = 1$ [h = 0.1].	**6**	**L3**	**CO4**
	b.	Find y(1.1) by using Runge-Kutta method of fourth order. Given $\frac{dy}{x} = x(y)^{1/3}$; $y(1) = 1$ [take h = 0.1].	**7**	**L2**	**CO4**
	c.	Using modern mathematical tools, write a code to find y(0.1) given $\frac{dy}{dx} = x - y$, $y(0) = 1$, by Taylor's series.	**7**	**L3**	**CO5**

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CBCS SCHEME

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

Mathematics-II for EEE Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Find the directional derivative of $\phi = xy^3 + yz^3$ at (2, -1, 1) along $i + 2j + 2k$.	7	L2	CO1
	b.	Find div $\vec{F}$ and curl $\vec{F}$, if $\vec{F} = y^3z^2\hat{i} + 3xy^2z^2\hat{j} + 2xy^3z\hat{k}$ at (1, -1, 1).	7	L2	CO1
	c.	If $\vec{V} = 3xy^2z^2\hat{i} + y^3z^2\hat{j} + 2y^2z^3\hat{k}$ and $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - zx)\hat{j} + (z^2 - xy)\hat{k}$, show that $\vec{V}$ is solenoidal and $\vec{F}$ is irrotational.	6	L2	CO1
		OR			
Q.2	a.	Find the workdone in moving a particle by the force field $\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$ along the straight line from (0, 0, 0) to (2, 1, 3).	7	L2	CO1
	b.	Using Green's theorem evaluate $\oint(xy - x^2)dx + x^2ydy$ over the region bounded by $y = x$ and $y = x^2$.	7	L3	CO1
	c.	Write the mathematical tool program to find the divergence of the vector field. $\vec{F} = x^2yz\hat{i} + y^2zx\hat{j} + z^2xy\hat{k}$.	6	L3	CO5
		Module – 2			
Q.3	a.	If W is the set of all points in R^3 satisfying the equation $a_1x_1 + a_2x_2 + a_3x_3 = 0$, then prove that W is a subspace of R^3.	7	L2	CO2
	b.	Prove that in $V_3(R)$, the vectors {(1, 2, 1), (2, 1, 0), (1, -1, 2)} are linearly independent.	7	L2	CO2
	c.	Prove that the transformation $T : R^3 \rightarrow R^3$ defined by $T(x_1, x_2, x_3) = (0, x_2, x_3)$ is linear.	6	L2	CO2
		OR			
Q.4	a.	Express the vector (2, -1, -8) as a linear combination of the vectors (1, 2, 1), (1, 1, -1) and (4, 5, -2).	7	L2	CO2
	b.	Find the matrix of the linear transformation $T : V_3(R) \rightarrow V_2(R)$ defined by $T(x, y, z) = (x + y, y + z)$ relative to the bases $B_1 = \{(1, 1, 0), (1, 0, 1), (1, 1, -1)\}$, $B_2 = \{(2, -3), (1, 4)\}$.	7	L2	CO2

	c.	Using the modern mathematical tool. Write the code to represent the reflection transformation $T : R^2 \to R^2$ and to find the image of vector (10, 0) when it is reflected about the y-axis.	6	L3	CO5
		Module – 3			
Q.5	a.	Find the Laplace transform of i) $te^{-t}\sin 3t$ ii) $\frac{e^{at}-e^{bt}}{t}$	7	L2	CO3
	b.	Find the Laplace transform of the square wave function of period 'a' defined by $f(t)=\begin{cases} E, & 0<t<a/2 \\ -E, & a/2<t<a \end{cases}$	7	L3	CO3
	c.	Express $f(t)=\begin{cases} t^2, & 0<t<2 \\ 4t, & 2<t<4 \\ 6, & t>4 \end{cases}$ interms of unit step function and hence find its Laplace transform.	6	L3	CO3
		OR			
Q.6	a.	Find $L^{-1}\left\{\frac{2s-1}{(s-1)(s-3)}\right\}$.	7	L2	CO3
	b.	Find $L^{-1}\left\{\frac{1}{s(s^2+a^2)}\right\}$ using convolution theorem.	7	L2	CO3
	c.	Solve by Laplace transform $\frac{d^2y}{dt^2}-\frac{dy}{dt}=0,\ y(0)=y'(0)=3$.	6	L3	CO3
		Module – 4			
Q.7	a.	Find the real root of the equation $x \sin x + \cos x = 0$ near $x = \pi$ by Newton-Raphson method.	7	L2	CO4
	b.	Using Newton's forward interpolation formula find y at x = 5 for the data:	7	L3	CO4

x	4	6	8	10
y	1	3	8	16

	c.	Find the interpolating polynomial using Newton's divided difference formula for the data:	6	L2	CO4

x	0	1	2	5
y	2	3	12	147

		OR			
Q.8	a.	Find the real root of the equation $x\log_{10}x = 1.2$ by Regula Falsi method between 2 and 3 (three iterations).	7	L2	CO4
	b.	Find y at x = 5, if y(1) = +3, y(3) = 9, y(4) = 30, y(6) = 132 using Lagrange's interpolation formula.	7	L2	CO4

	c.	Evaluate $\int_0^{\pi/2} \sqrt{\cos x}\, dx$ by using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking 6 equal parts.	**6**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Use Taylor's series method to find y(0.1) by considering upto 3rd degree term, given $\frac{dy}{dx} = x - y^2$, $y(0) = 1$.	**7**	**L3**	**CO4**
	b.	Given $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$, $h = 0.1$ using Runge-Kutta method of 4th order find y at $x = 0.1$.	**7**	**L3**	**CO4**
	c.	Apply Milne's predictor-corrector method, find y(0.4) given $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$, $y(0.1) = 1.1113$, $y(0.2) = 1.2507$, $y(0.3) = 1.426$.	**6**	**L2**	**CO4**
		OR			
Q.10	**a.**	Using modified Euler's method, find y(0.1) given that $\frac{dy}{dx} = x^2 + y$ and $y(0) = 1$, take $h = 0.05$ and perform two iterations in each stage.	**7**	**L2**	**CO4**
	b.	Apply Milne's method to find y(4.4) given that $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0142$ and $\frac{dy}{dx} = \frac{2 - y^2}{5x}$.	**7**	**L2**	**CO4**
	c.	Write a modern mathematical tool program to solve $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$, $h = 0.1$ using R – K method of 4th order.	**6**	**L3**	**CO5**

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CBCS SCHEME

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, June/July 2024
Mathematics – II for EEE Stream

Time: 3 hrs. (4) Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Find the directional derivatives of $\phi = x^2yz + 4xz^2$, at (1, 2, -1) along $2i - j - 2k$.	7	L3	CO1
	b.	Find div $\vec{F}$ and curl $\vec{F}$, where $\vec{F} = \text{grad}(x^3 + y^3 + z^3 - 3xyz)$.	7	L3	CO1
	c.	Show that the vector, $\vec{F} = \dfrac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational.	6	L2	CO1
		OR			
Q.2	a.	Find the work done in moving a particle in the Force field $F = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$ along the straight line from (0, 0, 0) to (2, 1, 3).	7	L3	CO1
	b.	Using Green's theorem, evaluate $\oint (xy + y^2)dx + x^2dy$ over the region bounded by the curves $y = x$ and $y = x^2$.	7	L3	CO1
	c.	Using modern mathematical tools, write a code to find the divergence and curl of the vector $x^2yz\,\hat{i} + y^2zx\,\hat{j} + z^2xy\hat{k}$.	6	L2	CO5
		Module – 2			
Q.3	a.	Define a subspace. Show that the intersection of two subspaces of a vector space V is also a subspace of V.	7	L2	CO2
	b.	Define a basis for a vector space. Determine whether or not the vectors : (2, 2, 1), (1, 3, 7), (1, 2, 2) form a basis of R^3.	7	L2	CO2
	c.	Show that $T : R^2 \to R^3$ given by $T(x, y) = (x + y, x - y, y)$ is a linear transformation.	6	L2	CO2
		OR			
Q.4	a.	Define linearly independent set of vectors and linearly dependent set of vectors. Show that the vectors (1, 4, 9), (3, 1, 4), (9, 3, 12) are linearly dependent.	7	L2	CO2
	b.	Verify the Rank-Nullity theorem for $T : R^3 \to R^3$ defined by $T(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$.	7	L2	CO2
	c.	Using the modern mathematical tool, write the code to represent the reflection transformation $T : R^2 \to R^2$ and to find the image of vector (10, 0) when it is reflected about the y – axis.	6	L2	CO5
		Module – 3			
Q.5	a.	Find the Laplace Transform of, (i) $e^{-3t}(2\cos 5t - 3\sin 5t)$ (ii) $\dfrac{\cos at - \cos bt}{t}$	7	L2	CO3

	b.	Find the Laplace transform of the triangular wave function, $f(t)=\begin{cases} t, & \text{if } 0 \le t \le a \\ 2a-t, & \text{if } a \le t \le 2a \end{cases}$	7	L2	CO3
	c.	Express $f(t)=\begin{cases} t^2, & 1<t\le 2 \\ 4t, & t>2 \end{cases}$ interms of Heaviside unit step function and hence find $L(f(t))$.	6	L3	CO3
		OR			
Q.6	a.	Find $L^{-1}\left[\frac{2s^2-6s+5}{s^3-6s^2+11s-6}\right]$.	7	L2	CO3
	b.	Find $L^{-1}\left[\frac{1}{s(s^2+a^2)}\right]$ using convolution theorem.	7	L2	CO3
	c.	Solve the differential equation by using Laplace Transform method. $y''+6y'+9y=12t^2e^{-3t}$, $y(0)=y'(0)=0$	6	L3	CO3
		Module – 4			
Q.7	a.	By Newton-Raphson method, find the root of $x\sin x+\cos x=0$, near $x=\pi$. Carryout the iteration upto four decimal places of accuracy.	7	L2	CO4
	b.	Using Lagrange's interpolation formula, find y at x = 2, using the points (0, -12), (1, 0), (3, 6), (4, 12)	7	L2	CO4
	c.	Using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule, evaluate $\int_0^{0.6} e^{-x^2}$ by taking seven ordinates.	6	L3	CO4
		OR			
Q.8	a.	Find a real root of the equation $x^3-4x-9=0$ correct to three decimal places by the method of False position in (2, 3)	7	L2	CO4
	b.	Construct Newton's forward interpolation polynomial for the data :	7	L2	CO4
	c.	Evaluate $\int_0^1 \frac{dx}{(1+x)^2}$ by using Simpson's $\left(\frac{3}{8}\right)^{th}$ rule, by taking 6 equal intervals.	6	L3	CO4
		Module – 5			
Q.9	a.	Use Taylor series method to find y(0.2) from $\frac{dy}{dx}=2y+3e^x$, with $y(0)=0$.	7	L3	CO5
	b.	Using R-K method of order 4, solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$ with $y(0)=1$ at $x=0.2$.	7	L3	CO5
	c.	Applying Milne's Predictor-Corrector method, find y(0.4), from $\frac{dy}{dx}=2e^x-y$, given that, $y(0)=2$, $y(0.1)=2.010$, $y(0.2)=2.040$, $y(0.3)=2.090$	6	L3	CO5
		OR			

x	0	1	2	3
f(x)	1	2	1	10

Q.10	**a.**	Solve by using modified Euler's method, $y' = 1 + \frac{y}{x}$, $y(1) = 2$ at $x = 1.2$ and $x = 1.4$.	**7**	**L3**	**CO5**
	b.	Using the Runge-Kutta method of fourth order find $y(1.1)$, given $\frac{dy}{dx} = xy^{\frac{1}{3}}$, taking $h = 0.1$, $y(1) = 1$.	**7**	**L3**	**CO5**
	c.	Using modern mathematical tools, write a code to find $y(1.4)$, given $\frac{dy}{dx} = x^2 + \frac{y}{2}$, $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$, by Milne's Predictor and Corrector method.	**6**	**L3**	**CO5**

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BMATE201

Second Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

Mathematics – II for EEE Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Find the angle between the surfaces $xy^2y = 3x + z^2$ and $3x^2 - y^2 + 2z = 1$ at the point (1, -2, 1).	7	L2	CO1
	b.	If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$, find div $\vec{F}$ and curl $\vec{F}$.	7	L2	CO1
	c.	Show that the vector $\vec{F} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational.	6	L3	CO1
		OR			
Q.2	a.	Find the total work done by the force $\vec{F} = 3xy\hat{i} - 5z\hat{j} + 10x\hat{k}$ along the curve $x = t^2 + 1$; $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$.	7	L2	CO1
	b.	Using Green's theorem, evaluate $\int_c (xy + y^2)dx + x^2dy$ where 'c' is the closed curve of the region bounded by $y = x$ and $y = x^2$.	7	L3	CO1
	c.	Using modern mathematical tools, write the code to find the find the gradient of $\phi = x^2y + 2xz - 4$.	6	L2	CO5
		Module – 2			
Q.3	a.	Define a Subspace. Show that the intersection of two subspaces of a vector V is also a subspace of V.	7	L2	CO2
	b.	Show that $T : R^3 \rightarrow R^3$ defined by $T(x, y, z) = (x, y, -z)$ is linear transformation.	7	L3	CO2
	c.	If $u = [2, -5, -1]^T$, $V = [-7, -4, 6]^T$, compute : i) $\langle u, v \rangle$ ii) $\|u\|^2$ iii) $\|v\|^2$ iv) $\|u + v\|^2$.	6	L2	CO2
		OR			
Q.4	a.	Define linearly independent and linearly dependent set of vectors. Test the vectors $v_1 = [3, 0, -6]^T$, $v_2 = [-4, 1, 7]^T$ and $v_3 = [-2, 1, 5]^T$ forms a basis.	7	L2	CO2
	b.	State Rank – Nullity Theorem. For the matrix $A = \begin{bmatrix} 1 & -4 & 9 & -7 \\ -1 & 2 & -4 & 1 \\ 5 & -6 & 10 & 7 \end{bmatrix}$, Find : i) Rank of A ii) Dim (Nul A) iii) Bases	7	L3	CO2

	c.	Using the modern mathematical tool, write the code to represent the reflection transformation $T : R^2 \to R^2$ and to find the image of vector (10, 0) when it is reflected about y – axis.	6	L2	CO5
		Module – 3			
Q.5	a.	Find the Laplace Transform of (i) $e^{-3t}\cos 2t$ ii) $\frac{\cos at - \cos bt}{t}$.	7	L2	CO3
	b.	Find the Laplace Transform of the square wave function of period Za, defined by $f(t) = \begin{cases} k & 0 < t < a \\ -k & a < t < 2a \end{cases}$.	7	L2	CO3
	c.	Explain $f(t) = \begin{cases} \cos t & 0 < t < \pi \\ \cos 2t & \pi < t < 2\pi \\ \cos 3t & t > 2\pi \end{cases}$ in term of the unit step function and hence find L[f(t)].	6	L3	CO3
		OR			
Q.6	a.	Find the inverse Laplace transformer of i) $\frac{2s-1}{s^2+4s+29}$ ii) $\frac{1}{(s-4)^2}$.	7	L2	CO3
	b.	Using the convolution theorem, find the inverse Laplace transform of $\frac{1}{(s-1)(s^2+1)}$.	7	L3	CO3
	c.	Solve by the Laplace transforms $y'' + k^2y = 0$, given that $y(0) = 2$, $y'(0) = 0$.	6	L2	CO3
		Module – 4			
Q.7	a.	Find the real root of $x \log_{10} x = 1.2$ by Regula – Falsi method correct to 2 decimal places the root lies between (2, 3).	7	L2	CO4
	b.	Find interpolating polynomical by Newton's divided difference formula for the data f(1) = 4, f(3) = 32, f(4) = 55 and f(6) = 119.	7	L2	CO4
	c.	Evaluate using Simpson's $\frac{1}{3}^{rd}$ rule $\int_0^6 \frac{e^x}{1+x} dx$ by taking six equal parts.	6	L2	CO4
		OR			
Q.8	a.	Find the real root of the equation $\cos x = xe^x$, using Newton's – Raphson method, correct to 3 decimal places taking $x_0 = 0.5$.	7	L2	CO4
	b.	Use Newton's backward interpolation formula to compute the value of y when x = 6, given that	7	L3	CO4

x	1	2	3	4	5
y	1	–1	1	–1	1

	c.	Evaluate $\int_0^5 \frac{dx}{4x+5}$, by Trapezoidal rule, taking 6 ordinates.	6	L2	CO4
		Module – 5			
Q.9	a.	Employ Taylors series method to find y(0.2), given that $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$.	7	L3	CO4
	b.	Using Modified Euler's method, find y(0.1) correct to 4 decimal places, given that $y' = x - y^2$, $y(0) = 1$, $h = 0.1$, perform 2 iterations.	7	L2	CO4
	c.	Employ Milne's predictor – corrector method given that $y' = x^2(1 + y)$ $y(1) = 1$, $y(1.1) = 1.233$, $y(1.2) = 1.548$, $y(1.3) = 1.979$ to find $y(1.4)$.	6	L3	CO4
		OR			
Q.10	a.	Solve $y' = \log_{10}(x + y)$, by modified Euler's method at $x = 0.2$ and $x = 0.4$ with $h = 0.2$, perform 2 iterations at each stage.	7	L2	CO4
	b.	Use 4th order Runge – Kutta method to solve $(x + y)\, y' = 1$ with $y(0.4) = 1$, at $x = 0.5$ correct to 4 decimal places.	7	L2	CO4
	c.	Using modern mathematical tools, write a code to find y(0.1), given $y' = x - y$, $y(0) = 1$ by Taylors series.	6	L3	CO5

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Mathematics – II for EEE stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	If $\vec{F} = \nabla(xy^3z^2)$ find div $\vec{F}$ and curl $\vec{F}$ at the points (1, -1, 1).	7	L2	CO1
	b.	Show that $\vec{F} = (y+z)i + (z+x)j + (x+y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{F} = \nabla\phi$.	7	L3	CO1
	c.	Using Green's theorem, evaluate $\oint_C (xy + y^2)dx + x^2dy$ over the region bounded by the curves $y = x$ and $y = x^2$.	6	L3	CO1
		OR			
Q.2	a.	Find the directional derivatives of $\phi = x^2yz + 4xz^2$ at (1, -2, -1) along $2i - j - 2k$.	7	L2	CO1
	b.	If $\vec{F} = xyi + yzj + zxk$, evaluate $\int_C \vec{F} \cdot \vec{dr}$ where C is the curve represented by $x = t, y = t^2, z = t^3, -1 \le t \le 1$.	7	L2	CO1
	c.	Using modern mathematical tools, write the code to find gradient of $\phi = x^2y + 2xz - 4$.	6	L3	CO5
		Module – 2			
Q.3	a.	Define Vector space, Subspace and Linear dependent.	7	L2	CO2
	b.	Find the dimension and basis of the subspace spanned by the vectors, (2, 4, 2), (1, -1, 0), (1, 2, 1) and (0, 3, 1) in V_3R.	7	L2	CO2
	c.	Prove that the following functions are linear transformation, $T : R^3 \rightarrow R^2$ defined by $T(x, y, z) = (y, -x, -z)$.	6	L2	CO2
		OR			
Q.4	a.	Determine whether the vectors $V_1 = (1, 2, 3)$, $V_2 = (3, 1, 7)$ and $V_3 = (2, 5, 8)$ are linearly dependent or linearly independent.	7	L2	CO2
	b.	Let $T : V \rightarrow W$ be a linear transformation defined by, $T(x, y, z) = (x+y, x-y, 2x+z)$. Find the range, null space, rank, nullity and hence verify the rank nullity theorem.	7	L2	CO2

	c.	Using the modern mathematical tool, write a code to verify whether the following vectors (2, 1, 5, 4) and (3, 4, 7, 8) are orthogonal.	6	L3	CO5
		Module – 3			
Q.5	a.	Find the Laplace transform of, $2^t + \frac{\cos 2t - \cos 3t}{t} + t\sin t$.	7	L2	CO3
	b.	Given $f(t) = \begin{cases} E, & 0 < t < \frac{a}{2} \\ -E, & \frac{a}{2} < t < a \end{cases}$ where $f(t+a) = f(t)$, show that $L[(f(t)] = \frac{E}{S}\tanh\left(\frac{aS}{4}\right)$.	7	L3	CO3
	c.	Express $f(t) = \begin{cases} \sin t, & 0 \le t < \pi \\ \sin 2t, & \pi \le t < 2\pi \\ \sin 3t, & t \ge 2\pi \end{cases}$ in terms of the Heaviside unit step function and hence find L[f(t)].	6	L3	CO3
		OR			
Q.6	a.	Find the inverse Laplace transform of, $\frac{1}{s(s+1)(s+2)(s+3)}$.	7	L2	CO3
	b.	Find $L^{-1}\left[\frac{S}{(S^2+a^2)^2}\right]$ using convolution theorem.	7	L3	CO3
	c.	Employ Laplace transform to solve the equation : $y'' + 5y' + 6y = 5e^{2t}$, $y(0) = 2$, $y'(0) = 1$.	6	L3	CO3
		Module – 4			
Q.7	a.	Using Newton-Raphson method, find the root that lies near $x = 4.5$ of the equation $\tan x = x$. Correct to four decimal places.	7	L2	CO4
	b.	The area of a circle (A) corresponding to diameter (D) is given below: D: 80, 85, 90, 95, 100 A: 5026, 5674, 6362, 7088, 7854 Find the area corresponding to diameter 105 using an appropriate interpolation formula.	7	L3	CO4
	c.	Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's $\frac{1}{3}^{rd}$ rule taking four equal parts.	6	L3	CO4
		OR			
Q.8	a.	Find the real root of $x\log_{10} x - 1.2 = 0$ by the method of False position. Carry out three iterations.	7	L2	CO4

	b.	Use Lagrange's interpolation formula to find y at x = 10 given, x: 5, 6, 9, 11 y: 12, 13, 14, 16	**7**	**L2**	**CO4**
	c.	Evaluate $\int_0^1 \frac{dx}{1+x}$ taking seven ordinates by applying Simpson's $\frac{3}{8}^{th}$ rule.	**6**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Use Taylor's series method to find y at x = 0.1 considering upto the third degree given that $\frac{dy}{dx} = x^2 + y^2$ and y(0) = 1.	**7**	**L2**	**CO4**
	b.	Given $\frac{dy}{dx} = 3x + \frac{y}{2}$, y(0) = 1. Compute y(0.2) by taking h = 0.2, using Runge-Kutta method of fourth order.	**7**	**L2**	**CO4**
	c.	Given that $\frac{dy}{dx} = x - y^2$ and the data y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762. Compute y at x = 0.8 by using Milne's method.	**6**	**L2**	**CO4**
		OR			
Q.10	**a.**	Using modified Euler's formula, compute y at x = 0.2 given that $\frac{dy}{dx} = x + y$, y(0) = 1 and h = 0.2	**7**	**L3**	**CO4**
	b.	Use fourth order Runge-Kutta method to compute y(1.1) given that $\frac{dy}{dx} = xy^{\frac{1}{3}}$, y(1) = 1 and h = 0.1	**7**	**L2**	**CO4**
	c.	Using modern mathematical tools, write the code to find the solution of $\frac{dy}{dx} = 1 + \frac{y}{x}$ at y(2) taking h = 0.2 and y(1) = 2 by Runge-Kutta method of order four.	**6**	**L3**	**CO5**

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