K S SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

DEPARTMENT OF APPLIED SCIENCE

COURSE FILE

BMATE101-MATHEMATICS FOR EEE STREAM-I

I SEM-2023-2024

FACULTY IN CHARGE

DR. LAKSHMI B

Assistant professor

Department of Applied Science

K. S. SCHOOL OF ENGINEERING AND MANAGEMENT
BENGALURU-560109
Department Applied Science
CALENDAR OF EVENTS: I ODD SEMESTER (2023-2024)
SESSION: SEP 2023 TO JAN 2024

Week No.	Month	Mon	Tue	Wed	Thu	Fri	Sat	Days	Activities
		Day							
1	SEP	4 *	5	6	7	8	9	6	4th-12th Sep 2023 First sem Induction program J7:J24
2	SEP	11**	12	13*	14	15	16DH	5	11**-Inaugural function 13*-Commencement of I sem regular classes
3	SEP	18H	19	20	21	22	23	5	18-Varasiddhi Vinayaka Vrata 23-Monday Time Table
4	SEP	25	26	27	28H	29	30	5	28-Eid-Milad 30-Thursday Time Table
5	OCT	2H	3	4	5	6	7DH	4	2-Gandhi Jayanthi
6	OCT	9	10	11	12	13	14 H	5	14- Mahalaya Amavasya
7	OCT	16	17	18	19	20	21DH	5	
8	OCT	23H	24H	25	26	27	28H	4	23-Mahanavami, Ayudhapooja 24- Vijayadasami 28 - Maharshi Valmiki Jayanti
9	OCT/NOV	30	31	1H	2	3 TA	4DH	4	1-Kannada Rajyothsava
10	NOV	6 T1	7 T1	8 T1	9	10	11	6	11-Wednesday Time Table T1-06,07,08-1st Internal Test
11	NOV	13	14H	15 BV	16 ASD	17	18DH	4	14-Balipadyami, Deepavali
12	NOV	20	21	22	23	24	25	6	25- Wednesday Time Table
13	NOV/DEC	27	28	29	30H	1	2DH	4	30- Kanakadasa Jayanti
14	DEC	4 T2	5 T2	6 T2	7 SSTP	8 SSTP	9 SSTP	6	T2-04,05,06-2nd Internal Test 7th-11th Softskill Training Program
15	DEC	11 SSTP	12	13	14	15	16DH	5	
16	DEC	18	19	20	21	22	23 TA	6	23- Monday Time Table
17	DEC	25 H	26	27	28	29	30	5	25- Christmas
18	JAN	1 T3	2 T3	3 T3	4 LT	5 LT	6DH	5	T3-01,02,03-3rd Internal Test
18	JAN	8LT	9LT	10LT	11LT	12	13	6	LT- 08,09,10,11 - Lab Test
18	JAN	15 H	16	17	18	19	20DH	4	15- Makara Sankranti
				Total No of Working Days : 100					

Total Number of working days (Excluding holidays and Tests)=82

H	Holiday
BV	Blue Book Verification
T1,T2,T3	Tests 1,2,3
ASD	Attendance & Sessional Display
DH	Declared Holiday
LT	Lab Test
TA	Test attendance
SSTP	Softskill Training Program

Monday	15
Tuesday	18
Wednesday	19
Thursday	18
Friday	20
Saturday	10
Total	**100**

K. Rama

Dr. K. RAMA NARASIMHA
Principal/Director
K S School of Engineering and Management
Bengaluru - 560 109

CVasudev

Dr. C. VASUDEV
Professor & HOD
Department of Applied Science
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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024(ODD SEMESTER) CLASS TIME TABLE

(w. e. f. 13/09/2023)

Class: I ECE 'F' | Lecture Hall: A114 | Class Teacher: Dr. Lakshmi B

DAY	8:40 -9:35	9.35-10.30	10.30-10.45	10.45 -11.40	11.40-12.35	12.35-1.20	1.20 -2.10	2.10-3.00	3.00-3.50
MONDAY	BCHEE102 (Dr AR)	BPLCK105B (BV)	TEA BREAK	BESCK104A (AD)	BMATE101 (Dr. LB)	LUNCH BREAK	BCHEE102 (Dr AR)	BCEDK103-Theory (HP)	
TUESDAY	BMATE101 (Dr. LB)	BESCK104A (AD)		BCHEE102 (Dr AR)	BKSKK107/ BKBKK107 (TR)		F1- BATCH (BPLCK105B-SN Lab No.- A201) F2- BATCH Library		
WEDNESDAY	F1-BATCH (BCHEE102- Dr SS/ Dr AR Lab No. A112) F2- BATCH (BMATE101- Dr. LB/SP Lab No. -B205)				BCHEE102 (Dr AR)		BESCK104A (AD)	BMATE101 (Dr. LB)	BPLCK105B (BV)
THURSDAY	BPLCK105B (BV)	BIDTK158 (SMP)	TEA BREAK	BENGK106 (SM)	BMATE101 (Dr. LB)		F2- BATCH (BPLCK105B-SN/BVS Lab No.- A201) F1- BATCH Library		
FRIDAY	F2 BATCH (BCHEE102- Dr AR/Dr. HRR Lab No. A112) F1 BATCH (BMATE101- Dr LB/SVV Lab No. -B205)				BESCK104A (AD)		BCEDK103-Lab (HP)		
SATURDAY	wednesday AS PER CALENDAR OF EVENTS								

CODE	SUBJECT	Hours /Week	STAFF
BMATE101	Mathematics for EES-I	4+3	Theory: Dr. lakshmi B (Dr. LB) Lab: F1-BATCH- Dr. Lakshmi B (Dr. LB)& Mrs. Vinutha S V (SVV) F2-BATCH -Dr. Lakshmi B (Dr. LB) & Mr. Sudhakar P (SP)
BCHEE102	Chemistry for EES	4+3	Theory: Dr. Anitha R (Dr. AR) Lab: F1-BATCH-Dr. Swarna S (Dr.SS)& Dr. Anitha R (Dr. AR) F2-BATCH-Dr. Anitha R (Dr. AR)& Dr. Radha H R (Dr.HRR)
BCEDK103	Computer Aided Engg.Drawings	2+3	Theory:Mr. Harish P (HP) Lab : HP/AMR
BESCK104A	Introduction to Civil Engineering	4	Mrs. Anrutha Dhiraj (AD)
BPLCK105B	Introduction Python Prog.	3+3	Theory: Ms. Bhargavi S (BVS) Lab: F1-BATCH- Mr. Sanjay Nayak (SN) F2-BATCH- Mr. Sanjay Nayak (SN) & Ms. Bhargavi V (BVS)
BENGK106	Communicative English	1	Mrs. Sindhu Shree M S (SM)
BKSKK107/ BKBKK107	Samkruthika/ Balake Kannada	1	Mr. Thimurthy R (TR)
BIDTK158	Innovation and Design thinking	1	Mr.Sasindran M Prabhu(SMP)

Time-table Coordinator

06/10/2023

Head of the Department
Dr. C VASUDEV
Professor & HOD
Department of Applied Science

Principal
Dr. K RAMA NARASIMHA
Principal/Director

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

DEPARTMENT OF APPLIED SCIENCE

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(w. e. f. 13/09/2023)

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Lecture Hall: A114

Class Teacher: Dr. Lakshmi B

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MONDAY	BCHEE102 (Dr.AR)	BPLCK105B (BV)	TEA BREAK	BESCK104A (AD)	BMATE101 (Dr. LB)	LUNCH BREAK			
TUESDAY	BMATE101 (Dr. LB)	BESCK104A (AD)		BCHEE102 (Dr.AR)	BKSKK107/ BKBKK107 (TR)		BCHEE102 (Dr.AR)	BCEDK103-Theory (HP)	
WEDNESDAY	F1-BATCH (BCHEE102- Dr.SS/ Dr.AR Lab No. A112) F2- BATCH (BMATE101- Dr. LB/SP Lab No. -B205)				BCHEE102 (Dr.AR)		F1- BATCH (BPLCK105B-BV,SS Lab No.- A201) F2- BATCH Library		
THURSDAY	BPLCK105B (BV)	BIDTK158 (SMP)	TEA BREAK	BENGK106 (SM)	BMATE101 (Dr. LB)		BESCK104A (AD)	BMATE101 (Dr. LB)	BPLCK105B (BV)
FRIDAY	F2 BATCH (BCHEE102- Dr.AR/Dr. HRR Lab No. A112) F1 BATCH (BMATE101- Dr.LB/SVV Lab No. -B205)				BESCK104A (AD)		F2- BATCH (BPLCK105B-SN/BVS Lab No.- A201) F1- BATCH Library		
SATURDAY	AS PER CALENDAR OF EVENTS						BCEDK103-Lab (HP)		

CODE	SUBJECT	Hours /Week	STAFF
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BCHEE102	Chemistry for EES	4+3	Theory: Dr. Anitha R (Dr. AR) Lab: F1-BATCH-Dr. Swarna S (Dr.SS)& Dr. Anitha R (Dr. AR) F2-BATCH-Dr. Anitha R (Dr. AR)& Dr. Radha H R (Dr.HRR)
BCEDK103	Computer Aided Engg.Drawings	2+3	Theory:Mr. Harish P (HP) Lab : HP/AMR
BESCK104A	Introduction to Civil Engineering	4	Mrs. Amrutha Dhiraj (AD)
BPLCK105B	Introduction Python Prog.	3+3	Theory: Ms. Bhargavi S (BVS) Lab: F1-BATCH- Ms. Bhargavi S (BVS), Mrs. Swathi Sarkar(SS) F2-BATCH- Mr. Sanjay Nayak (SN) & Ms. Bhargavi V (BVS)
BENGK106	Communicative English	1	Mrs. Sindhu Shree M S (SM)
BKSKK107/ BKBKK107	Samkruthika/ Balale Kannada	1	Mr. Thimurthy R (TR)
BIDTK158	Innovation and Design thinking	1	Mr.Sasindran M Prabhu(SMP)

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109

DEPARTMENT OF MATHEMATICS

SESSION: 2023-2024 (ODD SEMESTER)

CO-PO MAPPING

Course: Mathematics for electrical and electronics engineering stream	
Type: Core	Course Code: BMATE101

No of Hours

Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
2:2	2	6	50

Marks

Internal Assessment	Examination	Total	Credits
50	50	100	3

Aim/Objectives of the Course

The goal of the course Calculus and Differential Equations – BMATE101 is

- To facilitate the students with a concrete foundation of differential calculus
- To solve the first and higher-order ordinary differential equations enabling them to acquire the knowledge of these mathematical tools.
- To develop the knowledge of matrices and linear algebra in a comprehensive manner.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the curvature of a curve.	**Applying (K3)**
CO2	Test the consistency of a system of linear equations and to solve them by direct and iterative methods.	**Applying (K3)**
CO3	Learn the notion of partial differentiation to calculate rate of change of multivariate functions and solve problems related to composite functions and Jacobians.	**Applying (K3)**
CO4	Solve first order linear/nonlinear differential equation analytically using standard methods	**Applying (K3)**
CO5	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume.	**Applying (K3)**

Syllabus Content

Module 1: **Differential Calculus-1:** Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems. **Self-study**: Center and circle of curvature, evolutes and involutes..(RBT Levels: L1, L2 and L3) **LO:** At the end of this session the student will be able to 1. Find the angle between the radius vector and tangent, angle between two curves. 2. Find the Pedal equation of the curve. 3. Find the curvature and radius of curvature, evolutes and involutes.	**CO1** 8hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2

Module 2 **Linear Algebra:** Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations; Gauss-elimination method, Gauss-Jordan method and Approximate solution by GaussSeidel method. Eigenvalues and Eigenvectors-Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. **Self-Study:** Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem. (RBT Levels: L1, L2 and L3). **LO:** At the end of this session the student will be able to 1. Define Rank of a matrix and echelon form. 2. Solve the system of equations using Gauss-elimination method, Gauss – Jordan method and Gauss-Seidel method. 3. Diagonalizable the square matrix	**CO2** 8hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2
Module-3:Series Expansion and Multivariable Calculus (8 hours) **Introduction of series expansion and partial differentiation in Computer Science & Engineering applications.** Taylor's and Maclaurin's series expansion for one variable (Statement only) - problems.Indeterminate forms - LHospital' s rule-Problems. Partial differentiation, total derivative - differentiation of composite functions. Jacobin and problems. Maxima and minima for a function of two variables. Problems. **Self-study:** Euler' s theorem and problems. Method of Lagrange' s undetermined multipliers with single constraint. **Applications:** Series expansion in computer programming, Computing errors and approximations. **(RBT Levels: L1, L2 and L3)LO:** At the end of this session the student will be able to 1. Obtain the series solution for the given functions.. 2. Evaluates the given limits.	**CO3** 8hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2

3.Find the Total derivatives, maxima and minima for a function of two variables.	
Module 4: **Module-4: Ordinary Differential Equations (ODEs) of First Order (8 hours)** Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations -Integrating factors on Orthogonal trajectories, L-R & C-R circuits. Problems. **Non-linear differential equations:** Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations. Problems. **Self-Study:** Applications of ODEs, Solvable for x and y. **Applications of ordinary differential equations:** Rate of Growth or Decay, Conduction of heat. **(RBT Levels: L1, L2 and L3)** **LO:** At the end of this session the student will be able to 1. Find the general and singular solution of the Clairaut's equation. 2. Find the orthogonal trajectories of the given family of curves. 3.Solve the ordinary differential equations of first order..	**CO4** 8 hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2
Module 5: **Multiple Integrals: Evaluation** of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integrals-Problems. **Beta-Gamma functions:** Definitions, Properties, relation between Beta and Gamma functions-Problems. **Self-Study: Center of gravity, Duplication formula.** **LO:** At the end of this session the student will be able to 1. Use the knowledge of double and triple integrals for finding area and volume. 2. Acquire the information about beta, gamma function and evaluate it in various problems.	**CO5** 8hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2

Text Books

1. **B.S. Grewal:** Higher Engineering Mathematics, Khanna Publishers, 43 Ed., 2015.
2. **E. Kreyszig:** Advanced Engineering Mathematics, John Wiley & Sons, 10 RdEd.(Reprint), 2016.

Reference Books (specify minimum two foreign authors text books)

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

5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H.K.Dass and Er. RajnishVerma:** "Higher Engineering Mathematics" S.Chand Publication (2014).
7. **James Stewart:** "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Useful Websites

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

Useful Journals

- Annals of Mathematics
- ActaMathematica
- International Journal of Mathematics
- Communications on pure and applied Mathematics.

Teaching and Learning Methods

1. Lecture class: 50hrs
2. Practical classes: 0

Assessment

Type of test/examination: Written examination/Activity

Continuous Internal Evaluation (CIE):

1. Three Unit Tests each of 25 Marks (Test duration: 75mins),best of two(avg) is taken and scaled down to 15mins

2. Two assignments of 10 Marks

3.The sum of two tests (conducted for 25 and scaled down to 15), two assignments(10marks)=25 marks

lab exam conducted for 50marks scaled down to 10 marks along with 15marks (record+ observation) =25marks

Total =50 marks

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

Semester End Exam (SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers

for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.

2. 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. The students have to answer 5 fullquestions, selecting one full question from each module.

SEE will be conducted for 100 marks (students have to answer all main questions) which will be reduced to 50 Marks.

Examination duration: 3 hrs.

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:**Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:**Environment and Society **PO8:**Ethics **PO9:**Individual & Team Work **PO10:** Communication **PO11:**Project Management & Finance **PO12:**Lifelong Learning

PSO1: Ability to apply concept of Mathematics in engineering to design a system, a component or a process/system to address a real world challenges

PSO2: Ability to develop effective communication, team work, entrepreneurial and computational skills

CO	PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
18 MAT11	K-level														
CO1	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO2	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO3	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO4	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO5	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2

Course In charge **Head of the Department** **Principal**

26.10.2022

I Semester

Course Title:	Mathematics for Electrical &Electronics Engineering Stream		
Course Code:	22MATE11 BMAS101	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+02
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Credits	04

Course objectives: The goal of the course **Calculus, Differential Equations and Linear Algebra** (**22MATE11**) is to

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

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 student's 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 for 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 Calculus (8 hours)

Introduction to polar coordinates and curvature relating to EC & EE Engineering applications. Polar coordinates, Polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Communication signals, Manufacturing of microphones, and Image processing.
(RBT Levels: L1, L2 and L3)

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

Introduction of series expansion and partial differentiation in EC & EE Engineering applications.
Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule. Problems.
Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.

Self-study: Euler's Theorem and problems. Method of Lagrange's undetermined multipliers with single constraint.
Applications: Series expansion in communication signals, Errors and approximations, and vector calculus.
(RBT Levels: L1, L2 and L3)

Module-3 Ordinary Differential Equations (ODEs) of first order (8 hours)

Introduction to first order ordinary differential equations pertaining to the applications for EC & EE engineering.
Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations - Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ *and* $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$. Applications of ODE's -Orthogonal trajectories, L-R and C-R circuits. Problems.
Non-linear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations. Problems.

Self-Study: Applications of ODE's, Solvable for x and y.

Applications of ordinary differential equations: L-R and C-R circuits, Rate of Growth or Decay, Conduction of heat.
(RBT Levels: L1, L2 and L3)

Module-4 Integral Calculus (8 hours)

Introduction to Integral Calculus in EC & EE engineering applications.
Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral. Problems.
Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Volume by triple integration, Center of gravity.
Applications: Antenna and wave propagation, Calculation of optimum power in electrical circuits, field theory.
(RBT Levels: L1, L2 and L3)

Module-5 Linear Algebra (8 hours)

Introduction of liner algebra related to EC & EE engineering applications.
Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. Problems

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

Applications of Linear Algebra: Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.
(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	**2D plots for Cartesian and polar curves**
2	**Finding angle between polar curves, curvature and radius of curvature of a given curve**
3	**Finding partial derivatives, Jacobian and plotting the graph**
4	**Applications to Maxima and Minima of two variables**
5	**Solution of first order differential equation and plotting the graphs**
6	**Program to compute area, volume and centre of gravity**
7	**Evaluation of improper integrals**
8	**Numerical solution of system of linear equations, test for consistency and graphical representation**
9	**Solution of system of linear equations using Gauss-Seidel iteration**
10	**Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power 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	apply the knowledge of calculus to solve problems related to polar curves.
CO2	learn the notion of partial differentiation to compute rate of change multivariate functions
CO3	apply the concept of change of order of integration and variables to evaluate multiple integral and their usage in computing area and volume.
CO4	make use of matrix theory for solving for system of linear equations and compute eigenvalues and eigenvectors
CO5	familiarize with modern mathematical tools namely SCILAB/PYTHON/MATLAB

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 sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):
Two Unit Tests each of 20 Marks (duration 01 hour)

- First test after the completion of 30-40 % of the syllabus
- Second test after completion of 80-90% of the syllabus

One Improvement test before the closing of the academic term may be conducted if necessary. However best two tests out of three shall be taken into consideration.

Two assignments each of 10 Marks

The teacher has to plan the assignments and get them completed by the students well before the closing of the term so that marks entry in the examination portal shall be done in time. Formative (Successive) Assessments include Assignments/Quizzes/Seminars/ Course projects/Field surveys/ Case studies/ Hands-on practice (experiments)/Group Discussions/ others. The Teachers shall choose the types of assignments depending on the requirement of the course and plan to attain the Cos and POs. (to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

The sum of two tests, two assignments, will be out of 60 marks and will be scaled down to 30 marks

CIE for the practical component of the Integrated Course

- 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 02/03 hours)** at the end of the 14^{th} /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 IPCC for **20 marks**.

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, 44^{th} Ed., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10^{th} Ed., 2018.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11^{th} Ed., 2017

2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., Newyork, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "Calculus"** Cengage Publications, 7th Ed., 2019.
8. **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.

Web links and Video Lectures (e-Resources):

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

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-
-
-

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

K.S. School of Engineering and Management, Bangalore – 560109

DEPARTMENT OF MATHEMATICS

ACADEMIC YEAR 2024-25

ENGINEERING MATHEMATICS -1 FOR ECE STREAM

QUESTION BANK

Module I – Differential Calculus – 1

1. Prove with the usual notation $\tan\phi = r\frac{d\theta}{dr}$
2. Find the angle between the radius vector and tangent for each of the following curve.
   i) $r = a\sec^2\left(\frac{\theta}{2}\right)$
   ii) $r^2\sin 2\theta = a^2$
   iii) $r^m = a^m\cos m\theta$ at $\theta = 0$
   iv) $r = a(1+\sin\theta)$
3. Show that the angle between the radius vector and tangent at any point on the curve equiangular spiral $r = a\,e^{\theta\cot\alpha}$ is constant
4. Find the slope of the curve $r^2\cos 2\theta = a^2$ at $\theta = \frac{\pi}{12}$
5. ST the tangent to the cardioid $r = a(1+\cos\theta)$ at the points $\theta = \frac{\pi}{3}$ and $\theta = \frac{2\pi}{3}$ are respectively parallel and perpendicular to the initial line
6. Find the angle of intersection for each of the following pairs of curves
   i) $r = a(1-\cos\theta)$, $r = 2a\cos\theta$
   ii) $r^2 = a^2\cos 2\theta$, $r = a(1+\cos\theta)$
   iii) $r = a\theta$, $r = \frac{a}{\theta}$
   iv) $r = 6\cos\theta$, $r = 2(1+\cos\theta)$
7. ST the given pairs of curves intersect each other orthogonally
   i) $r = a(1+\cos\theta)$, $r = b(1-\cos\theta)$
   ii) $r = a\sec^2\left(\frac{\theta}{2}\right)$, $r = b\,\mathrm{cosec}^2\left(\frac{\theta}{2}\right)$
   iii) $r = 4\sec^2(\theta/2)$ and $r = 9\,\mathrm{cosec}^2(\theta/2)$
   iv) $r^n = a^n\cos n\theta$ and $r^n = b^n\sin n\theta$

Pedal equations

1) Find the pedal equation of the curves
   i) $r = a(1+\cos\theta)$
   ii) $r^m\cos m\theta = a^m$
   iii) $r^2 = a^2\sin^2\theta$
   iv) $r = a\,e^{m\theta}$
   v) $r = a\,e^{\theta\cot\alpha}$
   vi) $r^m = a^m(\cos m\theta + \sin m\theta)$
   v) $r^n = a^n\cos n\theta$
2. Show that the pedal equation of the Lemniscate $r^2 = a^2\cos 2\theta$ is $a^2p = r^3$

Module II – Differential Calculus – 2

Taylor's and Maclaurin's Series

1. Using Maclaurin's series expand $e^x \cos x$
2. Obtain the Taylors expansion of $\log x$ about $\log(1.1)$
3. Expand $f(x) = \cos x$ in a series of power of $\left(x - \frac{\pi}{3}\right)$
4. Obtain the Maclaurin's series of the function $e^x \log(1 + x)$
5. Obtain the Maclaurin'' sexpansion of $\log(1 + e^x)$

Indeterminate forms: Evaluate the following

1) $\lim\limits_{x \to 0} x^{\sin x}$

4) $\lim\limits_{x \to 0} \left(\frac{a^x + b^x}{2}\right)^{1/x}$

2) $\lim\limits_{x \to 0} \left(\frac{\tan x}{x}\right)^{1/x}$

5) $\lim\limits_{x \to \pi/2} (2x \tan x - \pi \sec x)$

3) $\lim\limits_{x \to 0} \left(\frac{\sin x}{x}\right)^{1/x^2}$

6) $\lim\limits_{x \to 0} \left(\frac{a^x + b^x + c^x + d^x}{4}\right)^{1/x}$

7) Find the constants a , b , c such that $\lim\limits_{x \to 0} \frac{a\,e^x - b\cos x + c e^{-x}}{x \sin x} = 2$

Partial Differentiation

1. If $u = \log\left(\frac{x^2 + y^2}{x + y}\right)$ ST $x\,u_x + y\,u_y = 1$
2. If $z = x^2 \tan^{-1}\left(\frac{y}{x}\right) - y^2 \tan^{-1}\left(\frac{x}{y}\right)$ ST $\frac{\partial^2 z}{\partial x\, \partial y} = \frac{x^2 - y^2}{x^2 + y^2}$
3. Verify that $\frac{\partial^2 u}{\partial x\, \partial y} = \frac{\partial^2 u}{\partial y\, \partial x}$ or $u_{xy} = u_{yx}$ for the following functions
   i) $u = \cos^{-1}(xy)$ ii) $u = e^{x \cos y + y \cos x}$
4. If $z = \sin(ax + y) + \cos(ax - y)$ PT $\frac{\partial^2 z}{\partial x^2} = a^2 \frac{\partial^2 z}{\partial y^2}$
5. If $v = e^{a\theta} \cos(a \log r)$ PT $\frac{\partial^2 v}{\partial r^2} + \frac{1}{r}\frac{\partial v}{\partial r} + \frac{1}{r^2}\frac{\partial^2 v}{\partial \theta^2} = 0$
6. If $u = \log\sqrt{x^2 + y^2 + z^2}$ ST $(x^2 + y^2 + z^2)\left[\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right] = 1$
7. If $\tan^{-1}\left(\frac{y}{x}\right)$ verify that a) $\frac{\partial^2 u}{\partial x\, \partial y} = \frac{\partial^2 u}{\partial y\, \partial x}$
   b) $\frac{\partial^3 u}{\partial y^2\, \partial x} = \frac{\partial^3 u}{\partial x\, \partial y^2} = \frac{\partial^3 u}{\partial y\, \partial x\, \partial y}$
8. If $z = \tan(y + ax) + (y - ax)^{3/2}$ ST $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2} = 0$
9. Verify $\frac{\partial^2 z}{\partial x\, \partial y} = \frac{\partial^2 z}{\partial y\, \partial x}$ if $z = \frac{xy}{y - x}$
10. If $z(x + y) = x^2 + y^2$ ST $\left(\frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)^2 = 4\left(1 - \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)$

Differentiation of composite functions:

1. If $u = f(r, s, t)$ and $r = \frac{x}{y}$, $s = \frac{y}{z}$, $t = \frac{z}{x}$ PT $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$

2. If $z = f(u,v)$ where $u = x - y, v = xy$ PT $x\frac{\partial^2 z}{\partial x^2} + y^2\frac{\partial^2 z}{\partial y^2} = (x+y)\left(\frac{\partial^2 z}{\partial u^2} + y^2\frac{\partial^2 z}{\partial v^2}\right)$

3. If $u = f(e^{y-z}, e^{z-x}, e^{x-y})$ PT $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$

4. If $z = f(x,y)$ and $x = u - v, y = uv$ ST a) $(u+v)\frac{\partial z}{\partial x} = u\frac{\partial z}{\partial u} - v\frac{\partial z}{\partial v}$

b) $(u+v)\frac{\partial z}{\partial y} = \frac{\partial z}{\partial u} + \frac{\partial z}{\partial v}$

5. If $u = f(x,y)$ where $x = r\cos\theta$, $y = r\sin\theta$ PT i) $r\frac{\partial u}{\partial r} = x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$

ii) $\frac{\partial u}{\partial \theta} = x\frac{\partial u}{\partial y} - y\frac{\partial u}{\partial x}$

6. If $x = u + v, y = vw + wu + uv, z = uvw$ and F is a function of x, y, z
ST $u\frac{\partial F}{\partial u} + v\frac{\partial F}{\partial v} + w\frac{\partial F}{\partial w} = x\frac{\partial F}{\partial x} + 2y\frac{\partial F}{\partial y} + 3z\frac{\partial F}{\partial z}$

Maxima and Minima for a function of two variables

1. Find the extreme values of the function $f(x,y) = x^3 + 3x^2 + 4xy + y^2$
2. Find the extreme values of the function $f(x,y) = x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$
3. Find the extreme values of the function $f(x,y) = x^4 + y^4 - 2(x-y)^2$
4. Find the extreme values of the function $f(x,y) = x^3y^2(1 - x - y)$
5. Find the extreme values of the function $f(x,y) = \sin x + \sin y + \sin(x+y)$

Jacobians

1) If $u = x^2 - 2y$ and $v = x + y$ find $\frac{\partial(u,v)}{\partial(x,y)}$

2) If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$ find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at $(1,-1,0)$

3) If $u + v = e^x\cos y$, $u - v = e^x\sin y$ find the Jacobian of the function u & v w.r.t. x & y

4) If $u = 2xy$, $v = x^2 - y^2$ and $x = r\cos\theta$, $y = r\sin\theta$ find $\frac{\partial(u,v)}{\partial(r,\theta)} = -4r^3$

5) If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$ evaluate $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at $(1,-1,0)$

Module IV – Integral Calculus

Solve the following Integrals:

1. $\int_0^1 \int_0^{x^2} e^{y/x}\, dy\, dx.$
2. $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{dy\, dx}{1+x^2+y^2}$.
3. $\int_1^2 \int_3^4 (xy + e^y)\, dx\, dy.$
4. $\int_0^1 \int_0^1 \frac{dy\, dx}{\sqrt{(1-x^2)(1-y^2)}}$.
5. $\int_0^1 \int_0^2 \int_1^2 xyz^2\, dz\, dy\, dx.$
6. $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz\, dx\, dy\, dz$.
7. $\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-x^2-y^2}} \frac{dz\, dy\, dx}{\sqrt{a^2-x^2-y^2-z^2}}$
8. $\int_0^{\log 2} \int_0^x \int_0^{x+\log y} e^{x+y+z}\, dx\, dy\, dz.$
9. $\int_0^1 \int_0^{1-x} \int_0^{1-x-y} dx\, dy\, dz.$

Evaluation of Double Integrals by changing the order of Integration:

1. Evaluate : $\int_0^3 \int_1^{\sqrt{4-y}} (x+y)\, dx\, dy$ by changing the order of integration.
2. Evaluate : $\int_0^1 \int_{\sqrt{y}}^{2-y} xy\, dx\, dy$ by changing the order of integration.
3. Evaluate : $\int_0^1 \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} dy\, dx$ by changing the order of integration.
4. Evaluate : $\int_0^a \int_{\sqrt{ax}}^{\sqrt{a}} \frac{y^2}{\sqrt{y^4-a^2x^2}}\, dx\, dy$ by changing the order of integration.
5. Evaluate : $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y}\, dy\, dx$ by changing the order of integration.
6. Evaluate : $\int_0^1 \int_x^{\sqrt{2-x^2}} \frac{x}{\sqrt{x^2+y^2}}\, dy\, dx$ by changing the order of integration.

Evaluation of Double Integrals by changing the order of Integration into Polar form:

1. Evaluate : $\int_0^a \int_0^{\sqrt{a^2-y^2}} y\sqrt{x^2+y^2}\, dx\, dy$ by changing into Polar form.
2. Evaluate : $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2(x^2+y^2)\, dy\, dx$ by transforming into Polar coordinates.
3. Evaluate : $\int_1^2 \int_1^{x^2} (x^2+y^2)\, dy\, dx$ by changing the order of integration into Polar form.
4. Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\, dx dy$ by changing to polar coordinates

Application of Double and Triple Integrals

1. Find by double integration the area enclosed by the curve $r = a(1+\cos\theta)$ between $\theta = 0$ and $\theta = \pi$

2. Find the volume of the solid bounded by the planes $x = 0, y = 0, z = 0$ and

$$x + y + z = 1$$

3. Find the area of the circle $x^2 + y^2 = a^2$ by double integration is πa^2

Beta and Gamma function

1. Show that $\int_0^\infty \sqrt{y}\, e^{-y^2}\, dy \times \int_0^\infty \frac{e^{-y^2}}{\sqrt{y}}\, dy = \frac{\pi}{2\sqrt{2}}$.

2. **Prove** that $\Gamma(1/2) = \sqrt{\pi}$

3. Evaluate $\int_0^{\frac{\pi}{2}} \sqrt{\cot\theta}\, d\theta$ by expressing intems of Gamma functions

4. Evaluate $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}}\, d\theta$

5. Evaluate $\int_0^2 (4 - x^2)^{\frac{3}{2}}\, dx$

6. Evaluate $\int_0^a x^4 \sqrt{a^2 - x^2}\, dx$

7. Evaluate $\int_{-1}^1 \sqrt{\frac{1+x}{1-x}}\, dx$

8. Evaluate $\int_0^\infty \frac{dx}{1+x^4}$

9. Evaluate $\int_0^2 (8 - x^3)^{-\frac{1}{3}}\, dx$

10. **Prove** that $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$

Module-III: ORDINARY DIFFERENTIAL EQUATIONS (ODES) OF FIRST ORDER

Linear Differential Equation:

Solve the following:

1. $\frac{dy}{dx} + y\cot x = \cos x$.
2. $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$.
3. $2y'\cos x + 4y\sin x = \sin 2x$ given $y(\pi/3) = 0$.

Bernoulli's Differential Equation:

Solve the following:

1. $\frac{dy}{dx} + \frac{y}{x} = y^2 x$.
2. $xy(1 + xy^2)\frac{dy}{dx} = 1$
3. $\frac{dy}{dx} + 2\frac{y}{x} = y^2\frac{\log x}{x}$.
4. $\frac{dy}{dx} + y\tan x = y^3\sec x$.
5. $\frac{dy}{dx} + y\tan x = y^2\sec x$.
6. $y(2xy + e^x)dx - e^x dy = 0$
7. $\frac{dy}{dx} + \frac{y}{x} = x^2y^6$
8. $\frac{dy}{dx} + \frac{y}{x} = x^3y^6$
9. $\frac{dy}{dx} - y\tan x = \frac{\sin x\cos^2 x}{y^2}$
10. $\frac{dy}{dx} - \frac{1}{2}\left(1 + \frac{1}{x}\right)y + \frac{3y^2}{x} = 0$

Exact differential equations:

Solve the following:

1. $(2x + y + 1)dx + (x + 2y + 1)dy = 0$.
2. $\frac{dy}{dx} + \frac{y\cos x + \sin y + y}{\sin x + x\cos y + x} = 0$.
3. $\frac{dy}{dx} + \frac{x + 3y - 4}{3x + 9y - 2} = 0$
4. $(5x^4 + 3x^2y^2 - 2xy^3)dx + (2x^3y - 3x^2y^2 - 5y^4)dy = 0$.
5. $(2xy + y - \tan y)dx + (x^2 - x\tan^2 y + \sec^2 y)dy = 0$.
6. $(y^3 - 3x^2y)dx - (x^3 - 3xy^2)dy = 0$.

Reducible to exact differential equations:

Solve the following:

1. $y(x+y+1)dx + x(x+3y+2)dy = 0$
2. $\left(1+e^{x/y}\right)dx + e^{x/y}\left(1-\frac{x}{y}\right)dy = 0$
3. $(8xy-9y^2)dx + 2(x^2-3xy)dy = 0$
4. $(x^2+y^2+x)dx + xydy = 0$
5. $(x^2+y^3+6x)dx + y^2xdy = 0$
6. $y\log y\, dx + (x-\log y)dy = 0$
7. $(xy^3+y)dx + 2(x^2y^2+x+y^4)dy = 0$
8. $(y^4+2y)dx + (xy^3+2y^4-4x)dx = 0$
9. $(4xy+3y^2-x)dx + x(x+2y)dy = 0$

Application of Differential Equation:

Orthogonal Trajectories:

(Cartesian form)

1. **Find** the orthogonal trajectories of the family $y^2 = cx^3$
2. **Find** the orthogonal trajectories of the family of Asteroid $x^{2/3} + = a^{2/3}$.
3. **Find** the orthogonal trajectories of the family of confocal ellipses $\frac{x^2}{a^2} + \frac{y^2}{b^2+\lambda} = 1$, where λ is parameter.
4. **Show** that the family of parabola $y^2 = 4a(x+a)$ is self-orthogonal.
5. **Show** that the family of curves $\frac{x^2}{a^2+\lambda} + \frac{y^2}{b^2+\lambda} = 1$ is self-orthogonal, where λ is parameter.

(Polar form)

1. **Find** the orthogonal trajectories of the family $r^n \cos n\theta = a^n$
2. **Find** the orthogonal trajectories of the family $r^n = a^n \sin n\theta$.
3. **Show** that the orthogonal trajectories of the family $r(1-\cos\theta) = a$ is the family $r(1+\cos\theta) = b$, where a,b are constants.
4. **Find** the orthogonal trajectories of the family $r = a(1-\cos\theta)$.
5. **Find** the orthogonal trajectories of the family of confocal and co-axial parabolas $r = \frac{2a}{1+\cos\theta}$

L-R and C-R circuits:

1. A series circuit with resistance **R**, inductance **L** with emf **E**, the current **I** and time **t** is given by $L\frac{di}{dt} + Ri = E\sin\omega t$. **Find** the current at anytime **t** with initial current $i = 0$.
2. When a resistance R is connected in series with an inductance L by an emf E volts, satisfies the equation $L\frac{di}{dt} + Ri = E$. If $E = 100\sin t$ volts and $i = 0$ when t=0, **find** the current as a function of time.
3. **Show that** differential equation for the current **I** in an electric circuit containing an inductance **L** and the resistance **R** in series acted by an emf $E\sin\omega t$ satisfies the equation:
$$L\frac{di}{dt} + Ri = E\sin\omega t.$$
Find the value of the current at any time **t**, if initially there is no current in the circuit.

4. When a switch is closed in a circuit containing battery **E**, resistance **R** and an inductance **L** the current **i** build up at a rate given by $L\frac{di}{dt} + Ri = E$. **Find I** as a function of t. **How long** will it be, before the current has reached one-half it's final value, is E=6 volts, R=100 ohm L=0.1 Henry?

Non-linear differential equations:

Solvable for p:

I Solve the following:

1. $y\left(\frac{dy}{dx}\right)^2 + (x-y)\frac{dy}{dx} - x = 0$
2. $p^2 + p(x+y) + xy = 0.$
3. $p^3 + 2xp^2 - y^2p^2 - 2xy^2p = 0$
4. $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$
5. $xyy'^2 - (x^2+y^2)y' + xy = 0$
6. $p^2 + 2py\cot x = y^2$
7. $p(p+y) = x(x+y)$

Clairaut's equations:

1. **Find** general solution and singular solution of $(a^2 - x^2)p^2 + 2xyp + b^2 - y^2 = 0.$
2. **Modify** the following equation into Clairaut' s form. Hence obtain the associated general and singular solutions. $xp^2 - py + kp + a = 0$
3. **Show that** $xp^2 + px - py + 1 - y = 0$ is Clairaut's equation. Hence obtain the general and singular solution.
4. **Solve** $y = px + \frac{a}{p}$ and obtain singular solution

Reducible to Clairaut's equations:

1. **Solve** the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut' s form, taking the substitution $X = x^2, Y = y^2$
2. **Solve** the equation $(px - y)(py + x) = a^2p$ by reducing into Clairaut' s form, taking the substitution $X = x^2, Y = y^2$
3. **Find** general solution of equation $x^2(y - px) = p^2y$ by reducing into Clairaut' s form, taking the substitution $X = x^2, Y = y^2$
4. Solve : $e^{4x}(p-1) + e^{2y}p^2 = 0$ by using the substitution $u = e^{2x}$ and $v = e^{2y}$

Module V – Linear Algebra

I. Find the rank of the following matrices

1. $A=\begin{bmatrix}0 & 2 & 3 & 4\\ 2 & 3 & 5 & 4\\ 4 & 8 & 13 & 12\end{bmatrix}$

2. $A=\begin{bmatrix}0 & 1 & -3 & -1\\ 1 & 0 & 1 & 1\\ 3 & 1 & 0 & 2\\ 1 & 1 & -2 & 0\end{bmatrix}$

3. $A=\begin{bmatrix}3 & -1 & 2\\ -6 & 2 & 4\\ -3 & 1 & 2\end{bmatrix}$

4. $A=\begin{bmatrix}1 & 2 & 4 & 3\\ 2 & 4 & 6 & 8\\ 4 & 8 & 12 & 16\\ 1 & 2 & 3 & 4\end{bmatrix}$

5. $A=\begin{bmatrix}1 & 2 & -2 & 3\\ 2 & 5 & -4 & 6\\ -1 & -3 & 2 & -2\\ 2 & 4 & -1 & 6\end{bmatrix}$

6. $A=\begin{bmatrix}1 & 2 & 3 & 2\\ 2 & 3 & 5 & 1\\ 1 & 3 & 4 & 5\end{bmatrix}$

7. $A=\begin{bmatrix}2 & 3 & -1 & -1\\ 1 & -1 & -2 & -4\\ 3 & 1 & 3 & -2\\ 6 & 3 & 0 & -7\end{bmatrix}$

8. $A=\begin{bmatrix}1 & 1 & 1 & 6\\ 1 & -1 & 2 & 5\\ 3 & 1 & 1 & 8\\ 2 & -2 & 3 & 7\end{bmatrix}$

9. $A=\begin{bmatrix}1 & 3 & -2\\ 2 & -1 & 4\\ 1 & -11 & 14\end{bmatrix}$

10. $A=\begin{bmatrix}91 & 92 & 93 & 94 & 95\\ 92 & 93 & 94 & 95 & 96\\ 93 & 94 & 95 & 96 & 97\\ 94 & 95 & 96 & 97 & 98\\ 95 & 96 & 97 & 98 & 99\end{bmatrix}$

II. Test for Consistency and Solve

1. $x+y+z=6,\ x-y+2z=5,\ 3x+y+z=8$
2. $x+2y+3z=14,\ 4x+5y+7z=35,\ 3x+3y+4z=21$
3. $x-4y+7z=14,\ 3x+8y-2z=13,\ 7x-8y+26z=5$
4. $5x+y+3z=20,\ 2x+5y+2z=18,\ 3x+2y+z=14$

III. Solve the following system of equations by Gauss elimination, Gauss-Jordan method.

1. $2x+5y+7z=52,\ 2x+y-z=0,\ x+y+z=9$
2. $x-2y+3z=2,\ 3x-y+4z=4,\ 2x+y-2z=5$
3. $x_1+x_2+x_3+x_4=2,\quad 2x_1-x_2+2x_3-x_4=-5,\ 3x_1+2x_2+3x_3+4x_4=7$

4. $x + y + z = 9,\ x - 2y + 3z = 8,\ 2x + y - z = 3$

5. $2x - y + 3z = 1, -3x + 4y - 5z = 0,\ x + 3y - 6z = 0$

6. $2x + 3y - z = 5,\ 4x + 4y - 3z = 3,\ 2x - 3y + 2z = 2$

7. $x + 2y + z = 3,\ 2x + 3y + 3z = 10,\ 3x - y + 2z = 13$

8. $5x_1 + x_2 + x_3 + x_4 = 4,\ x_1 + 7x_2 + x_3 + x_4 = 12,\ x_1 + x_2 + 6x_3 + x_4 = -5,$
   $x_1 + x_2 + x_3 + 4x_4 = -6$

9. $2x_1 - x_2 + x_3 = -1, 2x_2 - x_3 + x_4 = 1,\ x_1 + 2x_3 - x_4 = -1, x_1 + x_2 + 2x_4 = 12$

IV. Solve the following system of equations by Gauss-Seidel method

1. $10x + 2y + z = 9,\ x + 10y - z = -22,\ -2x + 3y + 10z = 22$
2. $x + y + 54z = 110,\ 27x + 6y - z = 85,\ 6x + 15y + 2z = 72$
3. $20x + y - 2z = 17,\ 3x + 20y - z = -18,\ 2x - 3y + 20z = 25$
4. $10x + y + z = 12,\ x + 10y + z = 12,\ x + y + 10z = 12$
5. $5x + 2y + z = 12,\ x + 4y + 2z = 15,\ x + 2y + 5z = 0$

V. Rayleigh power method

1. Using Rayleigh's power method find the dominant Eigenvalue and the corresponding Eigen vector of $\begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking $[1 \quad 0.8 \quad -0.8]^T$ as initial Eigen vector.

2. Using Rayleigh's power method find the dominant Eigenvalue and the corresponding Eigen vector of $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by taking $[1 \quad 0 \quad 0]^T$ as initial Eigen vector.

3. Using Rayleigh's power method find the dominant Eigenvalue and the corresponding Eigen vector of $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by taking $[1 \quad 1 \quad 1]^T$ as initial Eigen vector.

4. Using Rayleigh's power method find the dominant Eigenvalue and the corresponding Eigen vector of $\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109
DEPARTMENT OF BASIC SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

LESSON PLAN

NAME OF THE STAFF : Dr.LAKSHMI . B

COURSE CODE/TITLE : BMATE101/MATHEMATICS FOR ELECTRICAL AND ELECTRONICS ENGINEERING STREAM - 1

SEMESTER/YEAR : I SEM / I (F-Section)

Sl. No.	Topic to be covered	Mode of Delivery	Teaching Aid	No. of Periods	Cumulative No. of Periods	Proposed Date	Delivery Date
	MODULE 1						
1	Polar curves - angle between the radius vector and tangent	L+D	BLACK BOARD	2	2	13/9/2023 14/9/2023	13/9/23 14/9/23
2	Angle between two curves.	L+D	BB	1	3	15/9/2023	19/9/23
3	Pedal Equations-Problems	L+D	BB	1	4	19/9/2023	21/9/23
4	Curvature and radius of curvature- Cartesian, Parametric forms	L+D	BB	2	6	20/9/2023 21/9/2023	23/9/23 25/9/23
5	Curvature and radius of curvature- Polar, Pedal forms.	L+D,	BB	2	8	23/9/2023 25/9/2023	27/9/23 3/10/23
6	**Tutorials:** Self Study- Center and circle of curvature, Evolutes and Involutes.	L+D	BB	2	-	26/9/2023 27/9/2023	4/10/23 5/10/23
7	**Tutorials:**Applications: Computer graphics, Image processing	L+D	BB	2	-	30/9/2023 3/10/23	9/10/23 10/10/23
8	**Practicals:** 2D plots for Cartesian and polar curve	L+D	BB	2	-	13/9/23 20/9/23 And 15/9/23 22/9/23	15/9/23 22/9/23 13/9/23 27/9/23

9	**Practicals:** Angle between two curves and radius of curvature.	L+D	BB	2	-	27/9/23 4/10/23 And 29/9/23 6/10/23	4/10/23 1/10/23 6/10/23 13/10/23
10	Taylor's and Maclaurin's series expansions for one variable	L+D	BB	2	10	4/10/23 5/10/23	11/10/23 12/10/23
11	Indeterminate forms - L'Hospital's rule.	L+D	BB	1	11	9/10/23	16/10/23
12	Assignment-1	......	----				
13	Partial differentiation; Total derivatives-differentiation of composite functions.	L+D	BB	2	13	10/10/23 11/10/23	16/10/23 17/10/23
14	Jacobian	L+D	BB	1	14	12/10/23	17/10/23
15	Maxima and minima for a function of two Variables	L+D	BB	2	16	16/10/23 17/10/23	18/10/23 19/10/23
16	**Tutorials:** Problem Solving **Self Study**-Euler's Theorem and Problems, Method of Lagrange undetermined multipliers with Single Constraint	L+D	BB	2	-	18/10/23 19/10/23	25/10/23 26/10/23
17	**Tutorials:** Problem Solving Applications: Series expansion in computer programming, Computing errors and approximations	L+D	BB	2	-	25/10/23 26/10/23	30/10/23 31/10/23
18	**Practical**: Maclaurin's series expansion, L'Hospitals rule, Partial differentiation	L+D	BB, D	2	-	11/10/23 18/10/23 And 13/10/23 20/10/23	18/10/23 25/10/23 20/10/23 27/10/23
19	**Practical**: Jacobians	L+D	BB,D	1	-	25/10/23 27/10/23	3/11/23 15/11/23
20	Linear Algebra-Rank of a matrix-Echelon form	L+D	BB	1	17	30/10/23	2/11/23
21	Consistency of System of linear equations	L+D	BB	1	18	31/10/23	4/11/23
22	Solution of system of linear equations- Gauss elimination method	L+D	BB	1	19	2/11/23	13/11/23

23	Gauss Jordon method	L+D	BB	1	20	9/11/23	15/11/23
24	Approximate solution by Gauss Seidal method	L+D	BB	2	22	11/11/23 13/11/23	16/11/23 20/11/23
25	Eigen values and Eigen vectors method	L+D	BB	1	23	15/11/23	22/11/23
26	Rayleigh's power method	L+D	BB	1	24	16/11/23	22/11/23
27	**Tutorials:Problem solving** **Self-Study**- Solution of System of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley-Hmilton theorem.	L+D	BB	2	-	20/11/23 21/11/23	22/11/23 24/11/23
28	Tutorials: Applications	L+D	BB	2	-	22/11/23 23/11/23	25/11/23 25/11/23
29	**Practical**: Consistency of System of linear equations. Gauss Seidal method	L+D	BB	1	-	3/11/23 15/11/23	22/11/23 10/11/23
30	**Practical**:Rayleigh's power method	L+D	BB	1	-	17/11/23 22/11/23	17/11/23 29/11/23
31	Assignment-2				-		
32	Exact Differential Equations	L+D	BB	1	25	25/11/23	26/11/23
33	Reducible to exact differential equations.	L+D	BB	1	26	27/11/23	28/11/23
34	Bernoulli's Differential equations	L+D	BB	1	27	28/11/23	29/11/23
35	Applications of ODE's-orthogonal trajectories.	L+D	BB	1	28	29/11/23	30/11/23
36	L-R & C-R circuits. Problems	L+D	BB	1	29	12/12/23	12/12/23
37	Nonlinear differential equations: Introduction to general and singular solutions ; Solvable for p only;	L+D	BB	1	30	13/12/23	13/12/23
38	Clairaut's and reducible to Clairaut's equations only	L+D	BB	2	32	14/12/23 18/12/23	14/12/23 18/12/23
39	**Tutorials:** Problem Solving **Self Study**- Applications of ODE's -L-R circuits, Applications of ODE's- Solvable for X and Y	L+D	BB	2	-	19/12/23 20/12/23	19/12/23 20/12/23
40	**Tutorials:** Applications of ordinary differential	L+D	BB	2	-	21/12/23	21/12/23

	equations: Rate of Growth or Decay, Conduction of heat,					23/12/23	23/12/23
41	**Practicals**:Solutions of first order differential equations and plotting the curve	L+D	BB	1	-	24/11/23 29/11/23	13/12/23 10/12/23
42	**Practicals**:Solutions of first order differential equations and plotting the curve	L+D	BB	1	-	1/12/23 13/12/23	20/12/23 15/12/23
43	Review of elementary integral calculus. Multiple integrals: Evaluation of double and triple integrals	L+D	BLACK BOARD	2	34	26/12/23 27/12/23	26/12/23 27/12/23
44	Evaluation of double integrals- change of order of integration	L+D	BLACK BOARD	1	35	28/12/23	28/12/23
45	Evaluation of double integrals- changing into polar co-ordinates.	L+D	BLACK BOARD	1	36	30/12/23	01/1/23
46	Applications to find area volume and centre of gravity	L+D	BLACK BOARD	2	38	7/1/23 8/1/23	11/1/23 13/1/23
47	Beta and Gamma functions: Definitions, Relation between beta and gamma functions		BLACK BOARD	2	40	9/1/23 10/1/23	16/1/23 17/1/23
48	**Tutorials:** Problem Solving Center of gravity, Duplication formula.	L+D	BLACK BOARD	2		11/1/23 16/1/23	18/1/23 18/1/23
49	**Tutorials:**Applications: Antenna and wave propagation, Calculation of optimum value in various geometries. Analysis of probabilistic models.	L+D	BLACK BOARD	2		17/1/23 18/1/23	20/1/23 20/1/23
50	**Practical**: Program to compute area, surface area, volume and centre of gravity	L+D	BLACK BOARD	1		15/12/23 20/12/23	22/12/23 27/12/23
51	**Practical**: Evaluation of improper integrals.	L+D	BLACK BOARD	1		22/12/23 27/12/23	29/12/23
52	**Revision**	L+D	BLACK BOARD	-		19/1/23 20/1/23	-

	Mode of Assignments and Instructions	Date
Assignment 1	Problem solving(Assignment)	30/10/23
Assignment 2	Problem solving (Assignment) and Model question paper solutions	1/12/23

Total No. of Lecture Hours = 40

Total No. of Tutorial Hours = 16

Total no. of Practical Classes=13

Course In charge

Head of the Department

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Principal

Dr. K. RAMA NARASIMHA
Principal/Director
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Bengaluru - 560 109

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE -560109

DEPARTMENT OF MATHEMATICS

SESSION: 2023-2024 (ODD SEMESTER)

FIRST ASSIGNMENT

Degree	: B.E		Semester :	1
Branch	: CSE /ECE streams		Course Code :	22MATS11/22MATE11
Course Title	: Engineering Mathematics- I		Max Marks :	25
Date	: 17/10/2023		Last Date for :	26/10/2023

Q No.	Question	Marks	K-Level	CO mapping
1	a) With the usual notation **prove that** $\tan\varphi = r\frac{d\theta}{dr}$. b) With usual notation prove that $\frac{1}{p^2}=\frac{1}{r^2}+\frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$ c)Using modern mathematical tool **write** a program/code to **plot** the sine and cosine curve	5	Applying K3	CO1
2	a) **Find the** angle between the curves $r=a(1+\cos\theta)$ and $r=b(1-cos\theta)$ b) **Find** the Pedal equation to the following curves i)$r^m = a^m(\cos m\theta + \sin m\theta)$ ii)$\frac{2a}{r}=(1+cos\theta)$ c) With the usual notation **prove that** $\rho=\frac{(1+y_1^2)^{3/2}}{y_2}$	5	Applying K3	CO1
3	a) **Find** the radius of curvature of the curve $\sqrt{x}+\sqrt{y}=\sqrt{a}$ at the point (a/4, a/4). b) **Show** that the radius of curvature for any point of the cycloid $x=a(\theta+\sin\theta)$, $y=a(1-\cos\theta)$ is $4a\cos\left(\frac{\theta}{2}\right)$ c) Using modern mathematical tool **write** a program/code to **plot** the curve $r=2\lvert\cos 2\theta\rvert$	5	Applying K3	CO1
4	a) **Expand** $\log(secx)$ up to the term containing x^6using Maclaurin's series. b) **Expand** $e^{\sin x}$ up to the term containing x^4using Maclaurin's series.	5	Applying K3	CO2
5	**Evaluate:** a) $\lim_{x\to0}\left(\frac{tanx}{x}\right)^{1/x}$ b) $\lim_{x\to0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{\frac{1}{4}}$	5	Applying K3	CO2

Course In charge

CVasudev 17/10/2023

HOD

Dr. C. VASUDEV
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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE -560109
DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
SECOND ASSIGNMENT

Degree : B.E		**Semester** : I	
Branch : CSE/ECE Stream		**Course Code** : BMATS/E101	
Course Title : Engineering Mathematics- I		**Max Marks** : 25	
Date : 20/11/2023		**Last Date** : 2/12/2023	

Q No.	Question	Marks	K-Level	CO mapping
1	a) If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ **show that** $x\,u_x + y\,u_y = 1$ b) If $u = f\left(\frac{x}{y},\frac{y}{z},\frac{z}{x}\right)$ **prove that** $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$ c) If $z = xy^2 + x^2y$ where $x = at^2, y = 2at$, **Find** the total derivative $\frac{dz}{dt}$ d) If $u = f(2x-3y, 3y-4z, 4z-2x)$ **Show that** $6\frac{\partial u}{\partial x} + 4\frac{\partial u}{\partial y} + 3\frac{\partial u}{\partial z} = 0$	5	K3 Applying	CO2
2	a) If $x+y+z = u, y+z = v$ and $z = uvw$ **Find** the value of $\frac{\partial(x,y,z)}{\partial(u,v,w)}$ b) If $u = x^2+y^2+z^2, v = xy+yz+zx$ and $w = x+y+z$ **Find** the value of $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ c) **Find** the extreme values of the function $f(x,y) = x^3+y^3-3x-12y+20$ d) **Show that** the function $f(x,y) = x^3+y^3-3xy+1$ is minimum at the point (1,1)	5	K3 Applying	CO2
3	a) **Find** the rank of the matrix $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	5	K3 Applying	CO3

6 copies

	b) **Find** the rank of the matrix $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$ c) **Test** for consistency and **Solve**: $x - 4y + 7z = 14, \quad 3x + 8y - 2z = 13, \; 7x - 8y + 26z = 5$ d) Using modern mathematical tool **write** a program/code to **test** the consistency of the equations, $x + 2y - z = 1, 2x + y + 4z = 2,$ $3x + 3y + 4z = 1$			
4	a) **Solve** by Gauss Elimination method $x + 2y + z = 3, \quad 2x + 3y + 3z = 10, \; 3x - y + 2z = 13$ b) **Solve** by Gauss Jordan method $2x + 5y + 7z = 52, \quad 2x + y - z = 0, \; x + y + z = 9$ c) **Solve** the following system of equations by Gauss – Seidel method $x + y + 54z = 110, \quad 27x + 6y - z = 85, \; 6x + 15y + 2z = 72$ d) **Solve** the system of equations using Gauss – Seidel method by taking $(0, 0, 0)$ as an initial approximate root $2x - 3y + 20z = 25,$ $20x + y - 2z = 17, 3x + 20y - z = -18$	5	K3 Applying	CO3
5	a) **Find** the largest Eigen values and Eigen vectors of the matrix using power method $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking the initial eigen vector as $[1, 0, 0]^T$ b) **Find** the largest Eigen values and Eigen vectors of the matrix using power method and **perform** 5 iterations $A = \begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$ by taking the initial eigen vector as $[0, 0, 1]^T$,	5	K3 Applying	CO3

Course In charge

HOD 21/11/2023
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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE -560109
DEPARTMENT OF MATHEMATICS
SESSION: 2023-2024 (ODD SEMESTER)
FIRST ASSIGNMENT

Degree	:	B.E	Semester	:	I
Branch	:	CSE /ECE streams	Course Code	:	22MATS11/22MATE11
Course Title	:	Engineering Mathematics- I	Max Marks	:	25
Date	:	17/10/2023	Last Date for	:	26/10/2023

Q No.	Question	Marks	K-Level	CO mapping
1	a) With the usual notation **prove that** $\tan\varphi = r\frac{d\theta}{dr}$. b) With usual notation prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$ c)Using modern mathematical tool **write** a program/code to **plot** the sine and cosine curve	5	Applying K3	CO1
2	a) **Find the** angle between the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$ b) **Find** the Pedal equation to the following curves i) $r^m = a^m(\cos m\theta + \sin m\theta)$ ii) $\frac{2a}{r} = (1+\cos\theta)$ c) With the usual notation **prove that** $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$	5	Applying K3	CO1
3	a) **Find** the radius of curvature of the curve $\sqrt{x}+\sqrt{y}=\sqrt{a}$ at the point (a/4, a/4). b) **Show** that the radius of curvature for any point of the cycloid $x = a(\theta+\sin\theta)$, $y = a(1-\cos\theta)$ is $4a\cos\left(\frac{\theta}{2}\right)$ c) Using modern mathematical tool **write** a program/code to **plot** the curve $r = 2\lvert\cos 2\theta\rvert$	5	Applying K3	CO1
4	a) **Expand** $\log(\sec x)$ up to the term containing x^6 using Maclaurin's series. b) **Expand** $e^{\sin x}$ up to the term containing x^4 using Maclaurin's series.	5	Applying K3	CO2
5	**Evaluate: a)** $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x}$ b) $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{\frac{1}{4}}$	5	Applying K3	CO2

Course In charge

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17/10/2023

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE -560109
DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
SECOND ASSIGNMENT

Degree	:	B.E	Semester	:	I
Branch	:	CSE/ECE Stream	Course Code	:	BMATS/E101
Course Title	:	Engineering Mathematics- I	Max Marks	:	25
Date	:	20/11/2023	Last Date	:	2/12/2023

Q No.	Question	Marks	K-Level	CO mapping
1	a) If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $x\,u_x + y\,u_y = 1$ b) If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$ c) If $z = xy^2 + x^2y$ where $x = at^2, y = 2at$, Find the total derivative $\frac{dz}{dt}$ d) If $u = f(2x-3y, 3y-4z, 4z-2x)$ Show that $6\frac{\partial u}{\partial x} + 4\frac{\partial u}{\partial y} + 3\frac{\partial u}{\partial z} = 0$	5	K3 Applying	CO2
2	a) If $x+y+z = u, y+z = v$ and $z = uvw$ Find the value of $\frac{\partial(x,y,z)}{\partial(u,v,w)}$ b) If $u = x^2+y^2+z^2, v = xy+yz+zx$ and $w = x+y+z$ Find the value of $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ c) Find the extreme values of the function $f(x,y) = x^3+y^3-3x-12y+20$ d) Show that the function $f(x,y) = x^3+y^3-3xy+1$ is minimum at the point (1,1)	5	K3 Applying	CO2
3	a) Find the rank of the matrix $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	5	K3 Applying	CO3

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE -560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

SECOND ASSIGNMENT

Degree	: **B.E**		**Semester**	:	**I**
Branch	: **CSE/ECE Stream**		**Course Code**	:	**BMATS/E101**
Course Title	: **Engineering Mathematics- I**		**Max Marks**	:	**25**
Date	: **20/11/2023**		**Last Date**	:	**2/12/2023**

Q No.	Question	Marks	K-Level	CO mapping
1	a) If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ **show that** $x\,u_x + y\,u_y = 1$ b) If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ **prove that** $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$ c) If $z = xy^2 + x^2y$ where $x = at^2, y = 2at$, **Find** the total derivative $\frac{dz}{dt}$ d) If $u = f(2x-3y, 3y-4z, 4z-2x)$ **Show that** $6\frac{\partial u}{\partial x} + 4\frac{\partial u}{\partial y} + 3\frac{\partial u}{\partial z} = 0$	5	K3 Applying	CO2
2	a) If $x+y+z = u, y+z = v$ and $z = uvw$ **Find** the value of $\frac{\partial(x,y,z)}{\partial(u,v,w)}$ b) If $u = x^2+y^2+z^2, v = xy+yz+zx$ and $w = x+y+z$ **Find** the value of $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ c) **Find** the extreme values of the function $f(x,y) = x^3+y^3-3x-12y+20$ d) **Show that** the function $f(x,y) = x^3+y^3-3xy+1$ is minimum at the point (1,1)	5	K3 Applying	CO2
3	a) **Find** the rank of the matrix $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	5	K3 Applying	CO3

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109
DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
I SESSIONAL TEST QUESTION PAPER
SET-A

USN										

Degree	:	B.E	Semester	:	I
Branch	:	CSE/ECE	Course Code	:	BMATS101/BMATE101
Course Title	:	Engineering Mathematics -I	Date	:	06/11/2023
Duration	:	75Minutes	Max Marks	:	25

Note: Answer ONE full question from each part.

Q No.	Question	Marks	K-Level	CO mapping
	PART-A			
1(a)	With the usual notation prove that $\tan\varphi = r\frac{d\theta}{dr}$.	5	K3 Applying	CO1
(b)	Find the angle between the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$	5	K3 Applying	CO1
(c)	Show that the radius of curvature for any point of the cycloid $x = a(\theta+\sin\theta)$, $y = a(1-\cos\theta)$ is $4a\cos\left(\frac{\theta}{2}\right)$.	5	K3 Applying	CO1
	OR			
2(a)	Find the Pedal equation of the curve $\frac{2a}{r} = (1+\cos\theta)$.	5	K3 Applying	CO1
(b)	With the usual notation prove that $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$	5	K3 Applying	CO1
(c)	Using modern mathematical tool write a program/code to plot the curve $r = 2\lvert\cos 2\theta\rvert$	5	K3 Applying	CO1
	PART-B			
3(a)	Expand $\log(\sec x)$ up to the term containing x^6 using Maclaurin's series.	5	K3 Applying	CO2
(b)	Evaluate: $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x}$	5	K2 Applying	CO2
	OR			
4(a)	Expand $e^{\sin x}$ up to the term containing x^4 using Maclaurin's series.	5	K3 Applying	CO2
(b)	Evaluate $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{\frac{1}{x}}$	5	K2 Applying	CO2

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

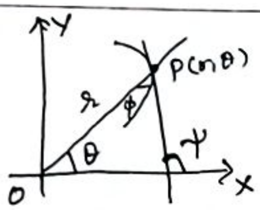
DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

I SESSIONAL TEST SCHEME & SOLUTION (SET A)

Degree	:	B.E	Semester	:	I
Branch	:	CSE/ECE	Course Code	:	BMATS101/BMATE101
Course Title	:	Engineering Mathematics -I	Date	:	06/11/2023
Duration	:	75Minutes	Max Marks	:	25

Note: Answer ONE full question from each part.

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	With the usual notation prove that $\tan\varphi = r\frac{d\theta}{dr}$.	
	 $\psi = \theta + \phi$ $\tan\psi = \frac{\tan\theta + \tan\phi}{1 - \tan\theta \times \tan\phi}$ —(1) $\tan\psi = \frac{dy}{dx} = \frac{\frac{d}{d\theta}(r\sin\theta)}{\frac{d}{d\theta}(r\cos\theta)} = \frac{r\cos\theta + r'\sin\theta}{-r\sin\theta + r'\cos\theta}$ $\tan\psi = \frac{\frac{r}{r'} + \tan\theta}{1 - \frac{r}{r'}\cdot\tan\theta}$ —(2) Comparing (1) & (2) we get, $\boxed{\tan\phi = r\frac{d\theta}{dr}}$	5
(b)	$r = a(1+\cos\theta)$; $r = b(1-\cos\theta)$ $\log r = \log a + \log(1+\cos\theta)$; $\log r = \log b + \log(1-\cos\theta)$ Diff w.r.t 'θ' $\frac{1}{r}\frac{dr}{d\theta} = -\frac{\sin\theta}{1+\cos\theta}$; $\frac{1}{r}\frac{dr}{d\theta} = \frac{\sin\theta}{1-\cos\theta}$ $\cot\phi_1 = -\tan\theta/2$; $\cot\phi_2 = \cot\theta/2$ $\cot\phi_1 = \cot(\pi/2 + \theta/2)$; $\phi_2 = \theta/2$	5

$$\phi_1 = \frac{\pi}{2} + \frac{\theta}{2} \quad ; \quad \phi_2 = \theta/2$$

$$|\phi_1 - \phi_2| = \left| \frac{\pi}{2} + \frac{\theta}{2} - \frac{\theta}{2} \right| = \frac{\pi}{2}$$

(c)	Show that the radius of curvature for any point of the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ is $4a\cos\left(\frac{\theta}{2}\right)$	

$x = a(\theta + \sin\theta) \quad : \quad y = a(1-\cos\theta)$

$\frac{dx}{d\theta} = a(1+\cos\theta) \quad ; \quad dy/d\theta = a\sin\theta$

$y_1 = a\sin\theta / a(1+\cos\theta) = \frac{\cancel{2}\sin\theta/_2 \cancel{\cos\theta/_2}}{\cancel{2}\cos^2\theta/_2}$

$y_1 = \tan\theta/_2$

$y_2 = \sec^2\theta/_2 \cdot \frac{1}{2} \cdot \frac{d\theta}{dx}$

$y_2 = \sec^2\theta/_2 \times \frac{1}{2} \times \frac{1}{a(1+\cos\theta)} = \frac{1}{4a}\sec^4\theta/_2$

$\rho = \frac{(1+y_1^2)^{3/2}}{y_2} = (1+\tan^2\theta/_2)^{3/2} \Big/ \frac{1}{4a}\sec^4\theta/_2 = 4a\cos\frac{\theta}{2}$

OR

2(a)	Find the Pedal equation of the curve $\frac{2a}{r} = (1 + \cos\theta)$.	5

$\frac{2a}{r} = 1 + \cos\theta$

$\log 2a - \log r = \log(1+\cos\theta)$

$0 - \frac{1}{r}\frac{dr}{d\theta} = \frac{-\sin\theta}{1+\cos\theta} = \frac{-\cancel{2}\sin\theta/_2 \cancel{\cos\theta/_2}}{\cancel{2}\cos^2\theta/_2}$

$\cot\phi = \tan\theta/_2$

$\cot\phi = \cot(\pi/_2 - \theta/_2)$

$\phi = \pi/_2 - \theta/_2$

$p = r\sin\phi = r\sin(\pi/_2 - \theta/_2) = r\cos\theta/_2$

PART-B		
3(a)	Expand log ($secx$) up to the term containing x^6 using Maclaurin's series.	
	$y(x) = \log(\sec x)$; $y(0) = \log 1 = 0$ $y_1 = \tan x$; $y_1(0) = 0$ $y_2 = \sec^2 x$; $y_2(0) = 1$ $y_2 = 1 + \tan^2 x$; $y_2 = 1 + y_1^2$; $y_2(0) = 1$ $y_3 = 2y_1 y_2$; $y_3(0) = 2 \times 0 = 0.$ $y_4 = 2[y_1 y_3 + y_2^2]$; $y_4 = 2\times 0 + 2\times 1 = 2$ $y_5 = 0$, $y_6 = 16$ $\therefore \log(\sec x) = \frac{x^2}{2} + \frac{x^4}{12} + \frac{x^6}{45}$	5
(b)	Evaluate: $\lim_{x \to 0} \left(\frac{tanx}{x}\right)^{1/x}$	
	$K = \lim_{x \to 0} \left(\frac{\tan x}{x}\right)^{1/x}$ $\log_e K = \lim_{x \to 0} \frac{1}{x} \log\left(\frac{\tan x}{x}\right)$ $\log K = \lim_{x \to 0} \frac{\log\left(\frac{\tan x}{x}\right)}{x}$ Apply L'H, $\log K = \lim_{x \to 0} \frac{\frac{1}{\left(\frac{\tan x}{x}\right)} \cdot \frac{x\sec^2 x - \tan x}{x^2}}{1}$ $\log_e K = \lim_{x \to 0} \frac{x\sec^2 x - \tan x}{x^2} = \lim_{x \to 0} \sec^2 x \cdot \tan x = 0$ $K = e^0 = 1$	5
OR		
4(a)	Expand $e^{\sin x}$ up to the term containing x^4 using Maclaurin's series.	5

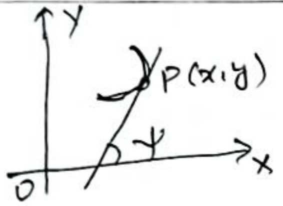
$$p = r\cos\theta/2$$

we have $\frac{2a}{r} = 1+\cos\theta$

$$\Rightarrow \frac{2a}{r} = 2\cos^2\theta/2 \quad \Rightarrow \cos\theta/2 = \frac{\sqrt{a}}{\sqrt{r}}$$

$$\therefore p = r\times\frac{\sqrt{a}}{\sqrt{r}} \Rightarrow p = \sqrt{r}\sqrt{a}$$

(b) With the usual notation prove that $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$ — 5



$$\tan\psi = \frac{dy}{dx}$$

Diff w.r.t 's'

$$\sec^2\psi\,\frac{d\psi}{ds} = \frac{d}{dx}\left(\frac{dy}{dx}\right)\cdot\frac{dx}{ds}$$

$$\Rightarrow \sec^2\psi\,\frac{d\psi}{ds} = \frac{d^2y}{dx^2}\times\frac{dx}{ds}$$

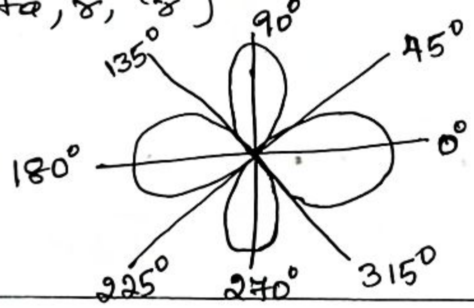
$$\sec^2\psi\left(\frac{1}{\rho}\right) = y_2\cos\psi$$

$$\therefore \rho = \frac{(\sec^2\psi)^{3/2}}{y_2} = \frac{(1+\tan^2\psi)^{3/2}}{y_2}$$

$$\therefore \rho = (1+y_1^2)^{3/2}/y_2$$

(c) Using modern mathematical tool write a program/code to plot the curve $r = 2|\cos 2\theta|$

```
from pylab import *
theta = linspace(0, 2*pi, 1000)
r = 2*abs(cos(2*theta))
polar(theta, r, 'r')
show()
```



$$y(x) = y(0) + x y_1(0) + \frac{x^2}{2} y_2(0) + \frac{x^3}{6} y_3(0) + \cdots$$

$y = e^{\sin x}$; $y_1(0) = e^0 = 1$

$y_1 = e^{\sin x}(\cos x)$; $y_1(0) = 1$

$y_1 = y \cos x$

$y_2 = -y \sin x + \cos x \times y_1$; $y_2(0) = 1$

$y_3 = -y_1 - 2y_1 \sin x + y_2 \cos x$; $y_3(0) = 0$

$\parallel^{ly}$ $y_4(0) = -3$

$e^{\sin x} = 1 + x + \frac{x^2}{2} - \frac{x^4}{8}$ //

(b) Evaluate $\lim_{x \to 0} \left(\frac{a^x + b^x + c^x + d^x}{4} \right)^{\frac{1}{x}}$

$$K = \lim_{x \to 0} \left(\frac{a^x + b^x + c^x + d^x}{4} \right)^{1/x}$$

$$\log K = \lim_{x \to 0} \frac{\log(a^x + b^x + c^x + d^x) - \log 4}{x}$$

$$= \lim_{x \to 0} \frac{\frac{1}{a^x + b^x + c^x + d^x} \{a^x \log a + b^x \log b + c^x \log c + d^x \log d\}}{1}$$

5

$$\log K = \frac{1}{4}\{\log a + \log b + \log c + \log d\} = \frac{1}{4} \log(abcd)$$

$$K = (abcd)^{1/4}$$

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Head of the Department 25/10/2022

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109
DEPARTMENT OF MATHEMATICS
SESSION: 2023-2024 (ODD SEMESTER)
I SESSIONAL TEST QUESTION PAPER
SET-B

USN

Degree	: B.E	Semester	: I
Branch	: CS/EC	Course Code	: BMATS/E101
Course Title	: Engineering Mathematics- I	Date	: 6/11/2023
Duration	: 75 Minutes	Max Marks	: 25

Note: Answer ONE full question from each part.

Q No.	Question	Marks	K-Level	CO mapping
	PART-A			
1(a)	With the usual notation prove that $\tan\varphi = r\frac{d\theta}{dr}$.	5	K3 Applying	CO1
(b)	Show that the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ intersect each other orthogonally.	5	K3 Applying	CO1
(c)	Using modern mathematical tool write a program/code to plot the curve $r = 2\lvert\cos 2\theta\rvert$	5	K3 Applying	CO1
	OR			
2(a)	With the usual notation prove that $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$	5	K3 Applying	CO1
(b)	Show that the radius of curvature for the curve $r^n = a^n cosn\theta$ varies inversely as r^{n-1}	5	K3 Applying	CO1
(c)	Find the Pedal equation of the curve $r^m = a^m(\cos m\theta + \sin m\theta)$	5	K3 Applying	CO1
	PART-B			
3(a)	Expand $\log(secx)$ up to the term containing x^4 using Maclaurin's series.	5	K3 Applying	CO2
(b)	Evaluate $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{\frac{1}{x}}$	5	K3 Applying	CO2
	OR			
4(a)	Obtain the Maclaurin's expansion of e^{sinx} up to the term containing x^6	5	K3 Applying	CO2
(b)	Evaluate $\lim_{x\to\pi/2}(\sin x)^{\tan x}$	5	K3 Applying	CO2

5

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

I SESSIONAL TEST SCHEME & SOLUTION(SET B)

Degree : B.E		Semester :	II
Branch : CS/EC		Course Code :	BMATS/E101
01Course Titl : Mathematics- I		Date :	06/11/23
Duration : 75 Minutes		Max Marks :	25

Note: Answer ONE full question from each part

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	With the usual notation **prove that** $\tan\varphi = r\frac{d\theta}{dr}$.	
	Diaglam & proof.	5
(b)	Show that the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ intersect each other orthogonally.	
	$\phi_1 = \frac{\pi}{2} + n\theta$ $\phi_2 = n\theta$ $\therefore \lvert\phi_1 - \phi_2\rvert = \lvert\frac{\pi}{2} + n\theta - n\theta\rvert = \frac{\pi}{2}$	5

(c) Using modern mathematical tool **write** a program/code to **plot** the curve $r = 2|\cos 2\theta|$ — 5

```
import numpy as np
from pylab import *
theta = linspace (0, 2 * pi, 1000)
r = 2 * abs (cos(2 * theta)
polar (theta, r, 'r')
show ( )
```

OR

2(a) With the usual notation **prove that** $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$ — 5

Diagram & proof.

(b) Show that the radius of curvature for the curve $r^n = a^n \cos n\theta$ varies inversely as r^{n-1}. — 5

$$\phi = \frac{\pi}{2} + n\theta$$

consider $p = r\sin\phi = r\sin\left(\frac{\pi}{2} + n\theta\right)$

we get $r^{n+1} = p a^n$ is the pedal form

Diff w.r.t p

$$(n+1) r^n \frac{dr}{dp} = a^n \Rightarrow \frac{dr}{dp} = \frac{a^n}{(n+1) r^n}$$

Also $$\rho = r\frac{dr}{dp} = r \frac{a^n}{(n+1) r^n} = \frac{a^n}{(n+1) r^{n-1}}$$

$$\therefore \rho = \left(\frac{a^n}{n+1}\right) \frac{1}{r^{n-1}}$$

(c)	Find the Pedal equation of the curve $r^m = a^m(\cos m\theta + \sin m\theta)$.	
	$\phi = \frac{\pi}{4} + m\theta$ caride p = r sin φ = r sin$(\frac{\pi}{4}+m\theta)$ $\Rightarrow p = \frac{r}{\sqrt{2}}(\cos m\theta + \sin m\theta)$ $\therefore r^{m+1} = \sqrt{2}\,a^m p$ is the pedal eqn.	5

PART-B

3(a)	Expand $\log(\sec x)$ up to the term containing x^4 using Maclaurin's series.	
	$y = \log(\sec x) \quad \therefore y(0) = \log 1 = 0$ $y_1(0) = 0;\ y_2(0) = 1;\ y_3(0) = 0;\ y_4(0) = 2$ $y(x) = y(0) + x y_1(0) + \frac{x^2}{2!} y_2(0) + \frac{x^3}{3!} y_3(0) + \frac{x^4}{4!} y_4(0)$ $= 0 + x(0) + \frac{x^2}{2}(1) + \frac{x^3}{6}(0) + \frac{x^4}{24}(2)$ $\therefore y(x) = \frac{x^2}{2} + \frac{x^4}{12}$	5
(b)	Evaluate $\lim_{x \to 0}\left(\frac{a^x + b^x + c^x + d^x}{4}\right)^{\frac{1}{x}}$	
	$K = \lim_{x \to 0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{1/x} = 1^\infty$ $\Rightarrow \log_e K = \lim_{x \to 0} \frac{1}{x}\log\left(\frac{a^x+b^x+c^x+d^x}{4}\right)$ $= \lim_{x \to 0} \frac{\log(a^x+b^x+c^x+d^x) - \log 4}{x} = \frac{0}{0}$ $= \lim_{x \to 0} \frac{1}{a^x+b^x+c^x+d^x}\left[a^x \log a + b^x \log b + c^x \log c + d^x \log d\right]$ $\Rightarrow \log_e K = \frac{1}{4}\log abcd = \log\sqrt[4]{abcd}$ $\therefore K = \sqrt[4]{abcd}$	5

OR

4(a)	Obtain the Maclaurin's expansion of $e^{\sin x}$ up to the term containing x^6.	
	$y = e^{\sin x} \therefore y(0) = e^0 = 1$ $y_1(0) = 1 ; y_2(0) = 1 ; y_3(0) = 0 ; y_4(0) = -3$ $y_5(0) = -2 ; y_6(0) = 3$ $y(x) = y(0) + x y_1(0) + \frac{x^2}{2} y_2(0) + \frac{x^3}{6} y_3(0) + \frac{x^4}{24} y_4(0) + \frac{x^5}{120} y_5(0) + \frac{x^6}{720} y_6(0)$ $y(x) = 1 + x(1) + \frac{x^2}{2}(1) + \frac{x^3}{6}(0) + \frac{x^4}{24}(-3) + \frac{x^5}{120}(-2) + \frac{x^6}{720}(3)$ $\therefore y(x) = 1 + x + \frac{x^2}{2} - \frac{x^4}{8} - \frac{x^5}{60} + \frac{x^6}{240}$.	5
(b)	Evaluate $\lim_{x\to\pi/2} (\sin x)^{\tan x}$.	
	$k = \lim_{x\to\frac{\pi}{2}} (\sin x)^{\tan x} = 1^\infty$ $\log_e k = \lim_{x\to\frac{\pi}{2}} \tan x \log(\sin x) = \infty \times 0$ $= \lim_{x\to\frac{\pi}{2}} \frac{\log(\sin x)}{\cot x} = \frac{0}{0}$ Applying L' Hospitall rule $\log_e k = 0$ $\therefore k = e^0 = 1$	5

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109
DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
II SESSIONAL TEST QUESTION PAPER
SET-A

USN: | | | | | | | | | | |

Degree	:	B.E	Semester	:	I
Branch	:	CSE, AI&DS, CSBS, ECE	Course Code	:	BMATS/E101
Course Title	:	Mathematics-I for CSE / ECE Stream	Date	:	04/12/2023
Duration	:	75 Minutes	Max Marks	:	25

Note: Answer ONE full question from each part.

Q No.	Question	Marks	K-Level	CO mapping
	PART-A			
1(a)	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	5	K3 Applying	CO2
(b)	if $u = x^2 + y^2 + z^2, v = xy + yz + zx$ and $w = x + y + z$ Find the value of $\frac{\partial(u,v,w)}{\partial(x,y,z)}$	5	K3 Applying	CO2
	OR			
2(a)	If $u = \log\left(\frac{x^2 + y^2}{x + y}\right)$ Show that $x\,u_x + y\,u_y = 1$	5	K3 Applying	CO2
(b)	Find the extreme values of the function $f(x,y) = x^3 + y^3 - 3x - 12y + 20$	5	K3 Applying	CO2
	PART-B			
3(a)	Solve the system of equations by Gauss Jordan method $x + y + z = 9,\ x - 2y + 3z = 8,\ 2x + y - z = 3$	5	K3 Applying	CO3
(b)	Solve the system of equations by Gauss elimination method $2x + 5y + 7z = 52,\ 2x + y - z = 0,\ x + y + z = 9$	5	K3 Applying	CO3
(c)	Solve the following system of equations by Gauss – Seidel method $10x + 2y + z = 9,\ x + 10y - z = -22,\ -2x + 3y + 10z = 22$	5	K3 Applying	CO3
	OR			
4(a)	Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$	5	K3 Applying	CO3

(b)	**Find** the largest Eigen values and Eigen vectors of the matrix using power method $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking the initial eigen vector as $[1, 0, 0]^T$	5	K3 Applying	CO3
(c)	**Test** for consistency and Solve $x + 2y + 3z = 14$, $4x + 5y + 7z = 35, 3x + 3y + 4z = 21$	5	K3 Applying	CO3

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109
DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

III SESSIONAL TEST SCHEME & SOLUTION (SET A)

Degree	:	B.E	Semester	:	I
Branch	:	CSE, AI&DS, CSBS, ~~ECE~~ ECE	Course Code	:	BMATS/E101
Course Title	:	Mathematics-I for ECE, CSE stream	Date	:	05/12/2023
Duration	:	75 Minutes	Max Marks	:	25

Note: Answer ONE full question from each part

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	
	$p = \frac{x}{y},\ q = \frac{y}{z},\ r = \frac{z}{x}$ $x\frac{\partial u}{\partial x} = \frac{x}{y}\frac{\partial u}{\partial p} - \frac{z}{x}\frac{\partial u}{\partial r}$ $y\frac{\partial u}{\partial y} = \frac{y}{z}\frac{\partial u}{\partial q} - \frac{x}{y}\frac{\partial u}{\partial p}$ $z\frac{\partial u}{\partial z} = \frac{z}{x}\frac{\partial u}{\partial r} - \frac{y}{z}\frac{\partial u}{\partial q}$ $\therefore\ x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	5
(b)	If $u = x^2 + y^2 + z^2, v = xy + yz + zx$ and $w = x + y + z$ **Find** the value of $\frac{\partial(u, v, w)}{\partial(x, y, z)}$	
	$J = \begin{vmatrix} 2x & 2y & 2z \\ y+z & x+z & y+x \\ 1 & 1 & 1 \end{vmatrix}$ $J = 0$	5
	OR	

2(a)	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ **Show that** $x u_x + y u_y = 1$	
	$u_x = \frac{2x}{x^2+y^2} - \frac{1}{x+y}$, $u_y = \frac{2y}{x^2+y^2} - \frac{1}{x+y}$ $x u_x + y u_y = \frac{2x^2}{x^2+y^2} + \frac{2y^2}{x^2+y^2} - \frac{x}{x+y} - \frac{y}{x+y}$ $= 2 - 1$ $= 1$	5
(b)	**Find** the extreme values of the function $f(x,y) = x^3 + y^3 - 3x - 12y + 20$	
	$f_x = 3x^2 - 3$, $f_y = 3y^2 - 12 \Rightarrow x = \pm 1$, $y = \pm 2$ $A = f_{xx} = 6x$, $B = f_{xy} = 0$, $C = f_{yy} = 6y$ $A = 6x$: (1,2) 6; (1,−2) 6; (−1,2) −6; (−1,−2) −6 $B = 0$: 0; 0; 0; 0 $C = 6y$: 12; −12; 12; −12 $AC - B^2$: 72; −72; −72; 72 conclusion: Min.pt; Saddle pt; Saddle pt.; Max. pt Max. value = 38, Min. value = 2	5
	PART-B	
3(a)	**Solve** the system of equations by Gauss Jordan method $x + y + z = 9$, $x - 2y + 3z = 8$, $2x + y - z = 3$	
	$[A:B] = \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 1 & -2 & 3 & : & 8 \\ 2 & 1 & -1 & : & 3 \end{bmatrix}$ $R_2 = R_2 - R_1$, $R_3 = R_3 - 2R_1$ $(A:B) = \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 0 & -3 & 2 & : & -1 \\ 0 & -1 & -3 & : & -15 \end{bmatrix}$ $R_1 = 3R_1 + R_2$, $R_3 = 3R_3 + R_2$ $= \begin{bmatrix} 3 & 0 & 5 & : & 26 \\ 0 & -3 & 2 & : & -1 \\ 0 & 0 & 11 & : & 44 \end{bmatrix}$ $\begin{bmatrix} 3 & 0 & 0 & : & 6 \\ 0 & -3 & 0 & : & -9 \\ 0 & 0 & 1 & : & 4 \end{bmatrix}$ $\therefore$ $x = 2, y = 3, z = 4$	5

(b) **Solve** the system of equations by Gauss elimination method

$2x + 5y + 7z = 52,\ 2x + y - z = 0,\ x + y + z = 9$

$$[A : B] = \left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 2 & 1 & -1 & 0 \\ 2 & 5 & 7 & 52 \end{array}\right]$$

$R_2 = R_2 - 2R_1,\ R_3 = R_3 - 2R_1$

$$= \left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 0 & -1 & -3 & -18 \\ 0 & 3 & 5 & 34 \end{array}\right]$$

$R_3 = R_3 + 3R_2$

$$\left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 0 & -1 & -3 & -18 \\ 0 & 0 & -4 & -20 \end{array}\right]$$

$\therefore x = 1,\ y = 3,\ z = 5$

5

3 (c) Solve the following system of equations by Gauss – Seidel method

$10x + 2y + z = 9,\ x + 10y - z = -22,\ -2x + 3y + 10z = 22$

$x^{(1)} = 0.9,\ y^{(1)} = -2.29,\ z^{(1)} = 3.067$

$x^{(2)} = 1.0513,\ y^{(2)} = -1.9984,\ z^{(2)} = 3.0097$

$x^{(3)} = 0.9987,\ y^{(3)} = -1.9989,\ z^{(3)} = 2.9989$

$x^{(4)} = 0.9986,\ y^{(4)} = -1.9987,\ z^{(4)} = 2.9988$

$\therefore x = \underline{0.9986},\ y = \underline{-1.9987},\ z = \underline{2.9988}$

OR

4(a) Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$

$$A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$$

$R_2 = R_2 - 2R_1,\ R_3 = R_3 - R_1$

$$A \sim \begin{bmatrix} 1 & 2 & 3 & 2 \\ 0 & -1 & -1 & -3 \\ 0 & 1 & 1 & 3 \end{bmatrix}$$

$R_3 = R_3 + R_2$

$$A \sim \begin{bmatrix} 1 & 2 & 3 & 2 \\ 0 & -1 & -1 & -3 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$\rho(A) = \underline{2}$

5

(b)	**Find** the largest Eigen values and Eigen vectors of the matrix using power method $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking the initial eigen vector as $[1, 0, 0]^T$		
	$Ax^{(0)} = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} = 4\begin{bmatrix} 1 \\ 0.5 \\ -0.5 \end{bmatrix}$, $\lambda_1 = 4, x^{(1)} = \begin{bmatrix} 1 \\ 0.5 \\ -0.5 \end{bmatrix}$ $Ax^{(1)} \Rightarrow \lambda_2 = 5, x^{(2)} = \begin{bmatrix} 1 \\ 0.8 \\ -0.8 \end{bmatrix}$ $\lambda_3 = 5.6 \quad x^{(3)} = \begin{bmatrix} 1 \\ 0.92 \\ -0.92 \end{bmatrix}$ $\lambda_4 = 5.856, x^{(4)} = \begin{bmatrix} 1 \\ 0.975 \\ -0.975 \end{bmatrix}$ $\lambda_5 = 5.95, x^{(5)} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ //	5	
4 (c)	**Test** for consistency and **Solve** $x + 2y + 3z = 14$, $4x + 5y + 7z = 35$, $3x + 3y + 4z = 21$		
	$[A:B] = \begin{bmatrix} 1 & 2 & 3 & : & 14 \\ 4 & 5 & 7 & : & 35 \\ 3 & 3 & 4 & : & 21 \end{bmatrix}$ $R_2 = R_2 - 4R_1,\ R_3 = R_3 - 3R_1$ $[A:B] \sim \begin{bmatrix} 1 & 2 & 3 & : & 14 \\ 0 & -3 & -5 & : & -21 \\ 0 & -3 & -5 & : & -21 \end{bmatrix}$ $R_3 = R_3 - R_2$ $(A:B) \sim \begin{bmatrix} 1 & 2 & 3 & : & 14 \\ 0 & -3 & -5 & : & -21 \\ 0 & 0 & 0 & : & 0 \end{bmatrix}$ $\rho(A) = \rho(A:B) = 2$ The system is consistent $x = \frac{k}{3}$, $y = 7 - \frac{5k}{3}$ $z = k$		

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109
DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
II SESSIONAL TEST QUESTION PAPER
SET-B

USN

Degree	:	B.E	Semester	:	I
Branch	:	CSE/CSBS/AI&DS/ECE	Course Code	:	BMATS/E101
Course Title	:	Mathematics-I for CSE/EC Stream	Date	:	04/12/2023
Duration	:	75 Minutes	Max Marks	:	25

Note: Answer ONE full question from each part.

Q No.	Question	Marks	K-Level	CO mapping
	PART-A			
1(a)	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ **show that** $x\,u_x + y\,u_y = 1$.	5	K3 Applying	CO2
(b)	**Find** the jacobian of u, v, w w. r. t x, y, z given $u = x + y + z$; $v = y + z$; $w = z$.	5	K3 Applying	CO2
	OR			
2(a)	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ **prove that** $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$.	5	K3 Applying	CO2
(b)	**Show that** the function $f(x,y) = x^3 + y^3 - 3xy + 1$ is minimum at the point(1,1).	5	K3 Applying	CO2
	PART-B			
3(a)	**Find** the rank of the matrix $A=\begin{bmatrix}1 & 2 & 3 & 2\\ 2 & 3 & 5 & 1\\ 1 & 3 & 4 & 5\end{bmatrix}$.	5	K3 Applying	CO3
(b)	**Solve** by Gauss elimination method: $x + y + z = 9$; $x - 2y + 3z = 8$; $2x + y - z = 3$.	5	K3 Applying	CO3
(c)	Test for Consistency and **Solve:** $x + 2y + 3z = 14$; $4x + 5y + 7z = 35$; $3x + 3y + 4z = 21$.	5	K3 Applying	CO3
	OR			
4(a)	**Solve** the following system of equations by Gauss-Jordan method: $2x + 5y + 7z = 52$, $2x + y - z = 0$, $x + y + z = 9$.	5	K3 Applying	CO3
(b)	**solve** the system of equations by Gauss – Seidel method: $x + y + 54z = 110.27\ x + 6y - z = 85, 6x + 15y + 2z = 72$.	5	K3 Applying	CO3
(c)	**Find** the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix}2 & 0 & 1\\ 0 & 2 & 0\\ 1 & 0 & 2\end{bmatrix}$ by the power method .	5	K3 Applying	CO3

5

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DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
II SESSIONAL TEST QUESTION PAPER
SET-B

USN

Degree	:	B.E	Semester	:	I
Branch	:	CSE/CSBS/AI&DS/ECE	Course Code	:	BMATS/E101
Course Title	:	Mathematics-I for CSE/EC Stream	Date	:	04/12/2023
Duration	:	75 Minutes	Max Marks	:	25

Note: Answer ONE full question from each part.

Q No.	Question	Marks	K-Level	CO mapping
	PART-A			
1(a)	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $x u_x + y u_y = 1$.	5	K3 Applying	CO2
(b)	Find the jacobian of u, v, w w.r.t x, y, z given $u = x + y + z$; $v = y + z$; $w = z$.	5	K3 Applying	CO2
	OR			
2(a)	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$.	5	K3 Applying	CO2
(b)	Show that the function $f(x,y) = x^3 + y^3 - 3xy + 1$ is minimum at the point(1,1).	5	K3 Applying	CO2
	PART-B			
3(a)	Find the rank of the matrix $A=\begin{bmatrix}1&2&3&2\\2&3&5&1\\1&3&4&5\end{bmatrix}$.	5	K3 Applying	CO3
(b)	Solve by Gauss elimination method: $x + y + z = 9$; $x - 2y + 3z = 8$; $2x + y - z = 3$.	5	K3 Applying	CO3
(c)	Test for Consistency and Solve: $x + 2y + 3z = 14$; $4x + 5y + 7z = 35$; $3x + 3y + 4z = 21$.	5	K3 Applying	CO3
	OR			
4(a)	Solve the following system of equations by Gauss-Jordan method: $2x + 5y + 7z = 52$, $2x + y - z = 0$, $x + y + z = 9$.	5	K3 Applying	CO3
(b)	solve the system of equations by Gauss – Seidel method: $x + y + 54z = 110.27$ $x + 6y - z = 85$, $6x + 15y + 2z = 72$.	5	K3 Applying	CO3
(c)	Find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix}2&0&1\\0&2&0\\1&0&2\end{bmatrix}$ by the power method .	5	K3 Applying	CO3

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

II SESSIONAL TEST SCHEME & SOLUTION(SET B)

Degree	:	B.E	Semester	:	II
Branch	:	CS/EC	Course Code	:	BMATS/E101
01Course Titl	:	Mathematics- I	Date	:	04/12/23
Duration	:	75 Minutes	Max Marks	:	25

Note: Answer ONE full question from each part

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $x u_x + y u_y = 1$.	
	$u = \log(x^2+y^2) - \log(x+y)$ $u_x = \frac{1}{x^2+y^2}(2x) - \frac{1}{x+y} = \frac{2x}{x^2+y^2} - \frac{1}{x+y}$ $u_y = \frac{1}{x^2+y^2}(2y) - \frac{1}{x+y} = \frac{2y}{x^2+y^2} - \frac{1}{x+y}$ $\therefore x u_x + y u_y = \frac{2x^2}{x^2+y^2} - \frac{x}{x+y} + \frac{2y^2}{x+y} - \frac{y}{x+y} = 1$	5
(b)	Find the jacobian of u, v, w w. r. t x, y, z given $u = x + y + z$; $v = y + z$; $w = z$.	
	$u_x = 1$; $u_y = 1$; $u_z = 1$ $v_x = 0$; $v_y = 1$; $v_z = 1$ $w_x = 0$; $w_y = 0$; $w_z = 1$ $J = \begin{vmatrix} u_x & u_y & u_z \\ v_x & v_y & v_z \\ w_x & w_y & w_z \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix}$ $\therefore J = 1$	5
	OR	

2(a)	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ **prove that** $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0.$	
	Let $p = \frac{x}{y}$; $q = \frac{y}{z}$; $r = \frac{z}{x}$ $\frac{\partial p}{\partial x} = \frac{1}{y}$; $\frac{\partial p}{\partial y} = \frac{-x}{y^2}$; $\frac{\partial p}{\partial z} = 0$ $\frac{\partial q}{\partial x} = 0$; $\frac{\partial q}{\partial y} = \frac{1}{z}$; $\frac{\partial q}{\partial z} = \frac{-y}{z^2}$ $\frac{\partial r}{\partial x} = -\frac{z}{x^2}$; $\frac{\partial r}{\partial y} = 0$; $\frac{\partial r}{\partial z} = \frac{1}{x}$ $\frac{\partial u}{\partial x} = \frac{\partial u}{\partial p}\frac{\partial p}{\partial x} + \frac{\partial u}{\partial q}\frac{\partial q}{\partial x} + \frac{\partial u}{\partial r}\frac{\partial r}{\partial x}$ $\frac{\partial u}{\partial x} = \frac{\partial u}{\partial p}\left(\frac{1}{y}\right) + 0 + \frac{\partial u}{\partial r}\left(\frac{-z}{x^2}\right)$ lly $\frac{\partial u}{\partial y}$; $\frac{\partial u}{\partial z}$ $\therefore x u_x + y u_y + z u_z = 0$.	5
(b)	**Show that** the function $f(x,y) = x^3 + y^3 - 3xy + 1$ is minimum at the point(1,1).	
	$f_x = 3x^2 - 3y \Rightarrow A = f_{xx} = 6x$ $f_y = 3y^2 - 3x \Rightarrow B = f_{xy} = -3$ $C = f_{yy} = 6y$ A at $(1,1) = 6 > 0$; B at $(1,1) = -3$; C at $(1,1) = 6$ $AC - B^2 = 36 - 9 = 27 > 0$ $\Rightarrow A > 0$ & $AC - B^2 > 0$ $\therefore$ the point $(1,1)$ is a minimum point	5
	PART-B	
3(a)	Find the rank of the matrix $A=\begin{bmatrix}1&2&3&2\\2&3&5&1\\1&3&4&5\end{bmatrix}$	
	$A = \begin{bmatrix}1&2&3&2\\2&3&5&1\\1&3&4&5\end{bmatrix}$ $R_2 \to R_2 - 2R_1$, $R_3 \to R_3 - R_1$ $\sim \begin{bmatrix}1&2&3&2\\0&-1&-1&-3\\0&1&1&3\end{bmatrix}$ $R_3 \to R_3 + R_2$ $\sim \begin{bmatrix}1&2&3&2\\0&-1&-1&-3\\0&0&0&0\end{bmatrix}$ $\therefore \rho(A) = 2$	5

(b) **Solve** by Gauss elimination method: x + y + z = 9 ; x − 2y + 3z = 8; 2x + y − z = 3.

$$[A:B] = \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 1 & -2 & 3 & : & 8 \\ 2 & 1 & -1 & : & 3 \end{bmatrix} \quad R_2 \to R_2 - R_1,\; R_3 \to R_3 - 2R_1$$

$$\sim \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 0 & -3 & 2 & : & -1 \\ 0 & -1 & -3 & : & -15 \end{bmatrix} \quad R_3 \to R_3 - \left(\frac{1}{3}\right)R_2$$

5

$$\sim \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 0 & -3 & 2 & : & -1 \\ 0 & 0 & 11 & : & 44 \end{bmatrix} \quad \begin{aligned} x+y+z &= 9 \\ -3y+2z &= -1 \\ 11z &= 44 \therefore z = 4 \end{aligned}$$

$-3y+8 = -1 \Rightarrow -3y = -9 \therefore y = 3$

$x+3+4 = 9 \therefore x = 2$ $\quad (2, 3, 4)$

(c) Test for Consistency and **Solve:**

x + 2y + 3z = 14; 4x + 5y + 7z = 35; 3x + 3y + 4z = 21.

$$(A:B) = \begin{bmatrix} 1 & 2 & 3 & : & 14 \\ 4 & 5 & 7 & : & 35 \\ 3 & 3 & 4 & : & 21 \end{bmatrix} \quad R_2 \to R_2 - 4R_1,\; R_3 \to R_3 - 3R_1$$

$$\sim \begin{bmatrix} 1 & 2 & 3 & : & 14 \\ 0 & -3 & -5 & : & -21 \\ 0 & -3 & -5 & : & -21 \end{bmatrix} \quad R_3 \to R_3 - R_2$$

5

$$\sim \begin{bmatrix} 1 & 2 & 3 & : & 14 \\ 0 & -3 & -5 & : & -21 \\ 0 & 0 & 0 & : & 0 \end{bmatrix} \quad \rho(A:B) = \rho(A) = 2 < n$$

infinite soln.

$x+2y+3z = 14$; $-3y - 5z = -21$ let $z = k$

$x = 14 - 2\left(\frac{21+5k}{3}\right) - 3k$ $\quad -3y - 5k = -21$, $y = \frac{-21+5k}{3}$

$\therefore x = k/3$

OR

4(a) **Solve** the following system of equations by Gauss-Jordan method:
2x + 5y + 7z = 52, 2x + y − z = 0, x + y + z = 9.

$$[A:B] = \begin{bmatrix} 2 & 5 & 7 & : & 52 \\ 2 & 1 & -1 & : & 0 \\ 1 & 1 & 1 & : & 9 \end{bmatrix} \quad R_1 \leftrightarrow R_3 \quad \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 2 & 1 & -1 & : & 0 \\ 2 & 5 & 7 & : & 52 \end{bmatrix}$$

$R_2 \to R_2 - 2R_1$, $R_3 \to R_3 + 2R_1$

5

$$\sim \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 0 & -1 & -3 & : & -18 \\ 0 & 3 & 5 & : & 34 \end{bmatrix} \quad R_3 \to R_3 - 3R_2 \quad \begin{bmatrix} 1 & 1 & 1 & : & 9 \\ 0 & -1 & -3 & : & -18 \\ 0 & 0 & 14 & : & 70 \end{bmatrix}$$

$R_1 \to R_1 + R_2$

$$\sim \begin{bmatrix} 1 & 0 & -2 & : & -9 \\ 0 & -1 & -3 & : & -18 \\ 0 & 0 & 14 & : & 90 \end{bmatrix} \quad R_1 \to R_1 + R_3$$

$$\sim \begin{bmatrix} 1 & 0 & 0 & : & 1 \\ 0 & -1 & 0 & : & -3 \\ 0 & 0 & 1 & : & 5 \end{bmatrix}$$

$\therefore z = 5$; $y = 3$; $x = 1$.

(b)	solve the system of equations by Gauss – Seidel method: $x + y + 54z = 110, 27x + 6y - z = 85, 6x + 15y + 2z = 72.$	
	$x = \frac{1}{27}[85 - 6y + z]$; $y = \frac{1}{15}(72 - 6x - 2z)$; $z = \frac{1}{54}[110 - x - y]$ Let $x^{(0)} = 0$; $y^{(0)} = 0$; $z^{(0)} = 0$ initially. 1st iteration $x^{(1)} = 3.148$; $y^{(1)} = 3.54$; $z^{(1)} = 1.913$ 2nd iteration: $x^{(2)} = 2.29$; $y^{(2)} = 3.572$; $z^{(2)} = 1.925$ 3rd iteration: $x^{(3)} = 2.425$; $y^{(3)} = 3.573$; $z^{(3)} = 1.925$ 4th iteration. $x^{(4)} = 2.425$; $y^{(4)} = 3.573$; $z^{(4)} = 1.925$ $\therefore x = 2.425$; $y = 3.573$ & $z = 1.925$.	5
(c)	**ind** the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ by the power method.	
	$A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ Let $X^{(0)} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ $AX^{(0)} = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} = 2\begin{bmatrix} 1 \\ 0 \\ 0.5 \end{bmatrix} = \lambda_1 X^{(1)}$ $AX^{(1)} = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \\ 0.5 \end{bmatrix} = \begin{bmatrix} 2.5 \\ 0 \\ 2 \end{bmatrix} = 2.5\begin{bmatrix} 1 \\ 0 \\ 0.8 \end{bmatrix} = \lambda_2 X^{(2)}$ $AX^{(2)} = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 0 \\ 0.8 \end{bmatrix} = \begin{bmatrix} 2.8 \\ 0 \\ 2.6 \end{bmatrix} = 2.8\begin{bmatrix} 1 \\ 0 \\ 0.92 \end{bmatrix}$ 1ly $\therefore \lambda = 3$; $X = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$.	5

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109
DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
III SESSIONAL TEST QUESTION PAPER (SET-A)

USN										

Degree	: B.E		Semester	:	I
Branch	: ECE		Course Code	:	BMATE101
Course Title	: Mathematics for electrical and Electronics Eng. Stream		Date	:	03/01/2024
Duration	: 75Minutes		Max Marks	:	25

Note: Answer ONE full question from each part.

Q No.	Question	Marks	K-Level	CO mapping
	PART-A			
1(a)	Solve: $\frac{dy}{dx} - y \tan x = \frac{\sin x \cos^2 x}{y^2}$	5	K3 Applying	CO4
(b)	Solve: $x^2p^2 + +xp - (y^2 + y) = 0$	5	K3 Applying	CO4
(c)	Solve the quation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form, taking the substitution $X = x^2$, $Y = y^2$	5	K3 Applying	CO4
	OR			
2(a)	Solve $(x^2 + y^2 + x)dx + xydy = 0$	5	K3 Applying	CO4
(b)	Obtain the general and singular solution the following equation as Clairait'sequation : $xp^3 - yp^2 + 1 = 0$	5	K3 Applying	CO4
(c)	Show that the family of parabolas $y^2 = 4a(x + a)$is self othogonal.	5	K3 Applying	CO4
	PART-B			
3(a)	Show that $\Gamma(1/2)=\sqrt{\pi}$	5	K3 Applying	CO5
(b)	Evaluate $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \pi$	5	K3 Applying	CO5
	OR			
4(a)	Evaluate $\int_0^1 \int_0^2 \int_1^2 xyz^2 \, dz\, dy\, dx$	5	K3 Applying	CO5
(b)	Evaluate : $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2(x^2 + y^2)\; dy\, dx$ by transforming into Polar form	5	K3 Applying	CO5

5

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DEPARTMENT OF APPLIED SCIENCE
SESSION: 2023-2024 (ODD SEMESTER)
~~II~~ I SESSIONAL TEST SCHEME & SOLUTION (SET A)

Degree	: B.E	Semester	: I
Branch	: ECE	Course Code	: BMATE101
Course Title	: Mathematics for ECE stream	Date	: 03/01/2024
Duration	: 75Minutes	Max Marks	: 25

Note: Answer ONE full question from each part.

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	Solve: $\frac{dy}{dx} - y\ \tan x = \frac{\sin x \cos^2 x}{y^2}$	
	$y^2\frac{dy}{dx} - y^3 \tan x = \sin x \cos^2 x$ put: $y^3 = t$, $3y^2\frac{dy}{dx} = \frac{dt}{dx}$ $\frac{dt}{dx} - (3\tan x)t = 3\sin x \cos^2 x$ $I.F = e^{-3\int \tan x\, dx} = (\sec x)^{-3} = \cos^3 x$ $\int t\cos^3 x = \int 3\sin x \cos^5 x\, dx$ $y^3 \cos^3 t = -\cos^6 x/2 + c$	5
(b)	Solve: $x^2p^2 + +xp - (y^2 + y) = 0$ $P = \frac{-x \pm (x+2xy)}{2x^2}$ $P = \frac{y}{x}$, $P = \frac{-2x-2xy}{2x^2} = -\frac{1}{x} - \frac{y}{x}$ $\frac{dy}{dx} = \frac{y}{x}$, $\frac{dy}{dx} + \frac{y}{x} = -\frac{1}{x}$ $\int \frac{dy}{y} = \int dx/x$, $\boxed{yx = -x + c}$ $\log y = \log x + \log c \Rightarrow \boxed{\frac{y}{x} = c}$,	5
(c)	Solve the quation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form, taking the substitution $X = x^2$, $Y = y^2$	

$X = x^2 \Rightarrow \frac{dX}{dx} = 2x$ & $Y = y^2 \Rightarrow \frac{dY}{dy} = 2y$

$p = \frac{x}{y} P \Rightarrow p = \frac{\sqrt{X}}{\sqrt{Y}} P$

On substitution we get, $\boxed{Y = PX - \frac{2P}{P+1}}$

clairaut's form.

OR

2(a)	Solve $(x^2 + y^2 + x)dx + xydy = 0$	
	$M = x^2+y^2+x$, $N = xy$ $\frac{\partial M}{\partial y} = 2y$, $\frac{\partial N}{\partial x} = y$. $\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} = y$ --- close to N. $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right) = \frac{1}{x} = f(x)$ $I.F = e^{\int 1/x\, dx} = x$ $\therefore M = x^3+xy^2+x^2$, $N = x^2y$ solution is $\int M dx + \int N(y) dy = c$ $x^4/4 + x^2y^2/2 + x^3/3 = c$	5
(b)	Obtain the general and singular solution the following equation as Clairait'sequation : $xp^3 - yp^2 + 1 = 0$	
	$xp^3 - yp^2 + 1 = 0$ Bringing to clairaut's form $y = xp + \frac{1}{p^2}$ General solution $y = cx + \frac{1}{c^2}$ Diff w.r.t 'c' $0 = x - 2/c^3 \Rightarrow c = \left(\frac{2}{x}\right)^{1/3}$ $\therefore y = \left(\frac{2}{x}\right)^{1/3} x + \frac{1}{(2/x)^{2/3}} \Rightarrow y \times 2^{2/3} = 3x^{2/3}$	5
(c)	Show that the family of parabolas $y^2 = 4a(x + a)$is self othogonal.	
	$y^2 = 4ax + 4a^2$ — (1) $2yy_1 = 4a \Rightarrow y_1 = \frac{yy_1}{2}$ (1) $\Rightarrow y^2 = 2yy_1\left(x + \frac{yy_1}{2}\right)$ or $\boxed{y = 2xy_1 + yy_1^2}$ Replace y_1 by $-1/y_1$, we get $\boxed{y = yy_1^2 + 2xy_1}$	

PART-B		
3(a)	Show that $\Gamma(1/2)=\sqrt{\pi}$	
	$\beta(m,n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$, $m=n=1/2$ $\beta(1/2, 1/2) = \dfrac{\Gamma(1/2)\Gamma(1/2)}{\Gamma(1)} = \dfrac{[\Gamma(\frac{1}{2})]^2}{1} = [\Gamma(1/2)]^2 \rightarrow (1)$ $\beta(m,n) = 2\int_0^{\pi/2} \sin^{2m-1}\theta \cos^{2n-1}\theta \, d\theta$ $\beta(1/2, 1/2) = 2\int_0^{\pi/2} 1 \cdot d\theta = 2[\theta]_0^{\pi/2} = \pi - (2)$ From (1) & (2) $\underline{\Gamma(1/2) = \sqrt{\pi}}$	5
(b)	Evaluate $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \pi$	
	$I_1 = \int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta = \int_0^{\pi/2} \sin^{1/2}\theta \cos^0\theta \, d\theta$ $p=1, q=0$ $I_1 = \frac{1}{2}\beta\left(\frac{p+1}{2}, \frac{q+1}{2}\right) = \frac{1}{2}\beta(3/4, 1/2)$ $\|^{ly}$ $I_2 = \frac{1}{2}\beta\left(\frac{-1/2+1}{2}, \frac{0+1}{2}\right) = \frac{1}{2}\beta(1/4, 1/2)$ $I_1 \times I_2 = \frac{1}{4}\beta(3/4, 1/2)\beta(1/4, 1/2) = \underline{\pi}$	5
OR		
4(a)	Evaluate $\int_0^1 \int_0^2 \int_1^2 xyz^2 \, dz\, dy\, dx$	
	$I = \int_{x=0}^{1} \int_{y=0}^{2} \left(\int_{z=1}^{2} z^2 \, dz\right) xy \, dy\, dx$ $= \int_{x=0}^{1} \int_{y=0}^{2} \left(\frac{z^3}{3}\right)_1^2 xy \, dy\, dx = \int_0^1 \int_{y=0}^{2} \left(\frac{8}{3} - \frac{1}{3}\right) xy \, dy\, dx$ $= \frac{7}{3}\int_0^1 x\left(\int_0^2 y\, dy\right) dx = \frac{7}{3}\int_0^1 x \times \left(\frac{y^2}{2}\right)_0^2 dx$ $= \frac{7\times 4}{6}\left(\frac{x^2}{2}\right)_0^1 = \frac{7\times 4}{12} = \frac{7}{3}$	5
(b)	Evaluate : $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2(x^2+y^2)\, dy\, dx$ by transforming into Polar form	5

$$I = \int_{\theta=0}^{\pi/2} \int_{r=0}^{a} (r\sin\theta)^2 \, r^2 \, r \, dr \, d\theta$$

where,
$x = r\cos\theta$
$y = r\sin\theta$
$dx\,dy = r\,dr\,d\theta$

$$I = \int_{\theta=0}^{\pi/2} \left(\int_{r=0}^{a} r^5 \, dr \right) \sin^2\theta \, d\theta$$

$$= \int_{\theta=0}^{\pi/2} \frac{a^6}{6} \sin^2\theta \, d\theta = \frac{a^6}{6} \int_0^{\pi/2} \left(\frac{1-\cos 2\theta}{2} \right) d\theta$$

$$= \frac{\pi a^6}{24}$$

Course In charge

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PART-B		
3(a)	Show that $\Gamma(1/2)=\sqrt{\pi}$	
	$\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$, $m=n=1/2$ $\beta(1/2,1/2) = \frac{\Gamma(1/2)\Gamma(1/2)}{\Gamma(1)} = \frac{[\Gamma(\frac{1}{2})]^2}{1} = [\Gamma(1/2)]^2 \to (1)$ $\beta(m,n) = 2\int_0^{\pi/2} \sin^{2m-1}\theta \cos^{2n-1}\theta \, d\theta$ $\beta(1/2,1/2) = 2\int_0^{\pi/2} 1 \cdot d\theta = 2[\theta]_0^{\pi/2} = \pi - (2)$ From (1) & (2) $\underline{\Gamma(1/2)=\sqrt{\pi}}$	5
(b)	Evaluate $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \pi$	
	$I_1 = \int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta = \int_0^{\pi/2} \sin^{1/2}\theta \cos^0\theta \, d\theta$ $p=1, \; q=0$ $I_1 = \frac{1}{2}\beta\left(\frac{p+1}{2}, \frac{q+1}{2}\right) = \frac{1}{2}\beta(3/4, 1/2)$ lly $I_2 = \frac{1}{2}\beta\left(\frac{-1/2+1}{2}, \frac{0+1}{2}\right) = \frac{1}{2}\beta(1/4, 1/2)$ $I_1 \times I_2 = \frac{1}{4}\beta(3/4, 1/2)\beta(1/4, 1/2) = \underline{\pi}$	5
OR		
4(a)	Evaluate $\int_0^1 \int_0^2 \int_1^2 xyz^2 \, dz\, dy\, dx$	
	$I = \int_{x=0}^{1} \int_{y=0}^{2} \left(\int_{z=1}^{2} z^2 dz\right) xy \, dy\, dx$ $= \int_{x=0}^{1}\int_{y=0}^{2} \left(\frac{z^3}{3}\right)_1^2 xy\, dy\, dx = \int_0^1 \int_{y=0}^{2} \left(\frac{8}{3}-\frac{1}{3}\right) xy\, dy dx$ $= \frac{7}{3}\int_0^1 x\left(\int_0^2 y\, dy\right) dx = \frac{7}{3}\int_0^1 x \times \left(\frac{y^2}{2}\right)_0^2 dx$ $= \frac{7\times4}{6}\left(\frac{x^2}{2}\right)_0^1 = \frac{7\times4}{12} = \frac{7}{3}$	5
(b)	Evaluate : $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2(x^2+y^2)\, dy\, dx$ by transforming into Polar form	5

$$I = \int_{\theta=0}^{\pi/2} \int_{r=0}^{a} (r \sin\theta)^2 \, r^2 \, r \, dr \, d\theta$$

where,
$x = r\cos\theta$
$y = r\sin\theta$
$dx\,dy = r\,dr\,d\theta$

$$I = \int_{\theta=0}^{\pi/2} \left(\int_{r=0}^{a} r^5 \, dr \right) \sin^2\theta \, d\theta$$

$$= \int_{\theta=0}^{\pi/2} \frac{a^6}{6} \sin^2\theta \, d\theta = \frac{a^6}{6} \int_0^{\pi/2} \left(\frac{1-\cos 2\theta}{2} \right) d\theta$$

$$= \frac{\pi a^6}{24}$$

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DEPARTMENT OF APPLIED SCIENCE

SESSION: 2023-2024 (ODD SEMESTER)

III SESSIONAL TEST SCHEME & SOLUTION (SET B)

Degree	:	B.E	Semester	:	I
Branch	:	ECE	Course Code	:	BMATE101
Course Title	:	Mathematics for EEE stream	Date	:	03/01/2024
Duration	:	75 Minutes	Max Marks	:	25

Note: Answer ONE full question from each part

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	Solve: $(4xy + 3y^2 - x)dx + (x^2 + 2xy)dy = 0$	
	$M = 4xy + 3y^2 - x$, $N = x^2 + 2xy$ $\frac{\partial M}{\partial y} = 4x + 6y$, $\frac{\partial N}{\partial x} = 2x + 2y$ $\frac{\partial M}{\partial y} \neq \frac{\partial N}{\partial x}$, ∴ The given eqn is not exact $f(x) = \frac{2}{x}$, $I.F = x^2$ soln $x^4 y + x^3 y^2 - \frac{x^4}{4} = c$.	5
(b)	Solve: $y\left(\frac{dy}{dx}\right)^2 + (x - y)\frac{dy}{dx} - x = 0$	
	$p = 1$, $p = -x/y$, $\frac{dy}{dx} = p$ $\frac{dy}{dx} = 1$, $\frac{dy}{dx} = -x/y$ $y - x - c = 0$, $x^2 + y^2 - c = 0$ soln $(y - x - c)(x^2 + y^2 - c) = 0$.	5

(c)	**Solve** the quation $(px-y)(py+x)=2p$ by reducing into Clairaut's form, taking the substitution $X=x^2, Y=y^2$	
	$P=\frac{dY}{dX}$ $\frac{dY}{dx}$ $\frac{dX}{dx}$ $=\frac{x}{y}P$ $Y=PX-\frac{2P}{P+1}$ Ⓐ $y^2=cx^2-\frac{2c}{c+1}$	5
OR		
2(a)	**Solve:** $\frac{dy}{dx}+\frac{y}{x}=y^2x$	
	$\frac{1}{y^2}\frac{dy}{dx}+\frac{1}{yx}=x$ put $\frac{1}{y}=t$ $\therefore$ $\frac{-1}{y^2}\frac{dy}{dx}=\frac{dt}{dx}$ $\Rightarrow$ $\frac{dt}{dx}-\frac{t}{x}=-x$ $IF=\frac{1}{x}$, soln: $\frac{1}{xy}=-x+c$	5
(b)	**Obtain** the general and singular solution the following equation as Clairait'sequation : $xp^3-yp^2+1=0$	
	$y=px+\frac{1}{p^2}$ is clairauts form general soln: $y=cx+\frac{1}{c^2}$ Singular soln: $4y^3=27x^2$	5

(c) **Find** the oryhogonal trajectories of the family of curves

$$\frac{x^2}{a^2} + \frac{y^2}{b^2 + \lambda} = 1$$

$$\frac{x}{a^2} = \frac{-y y_1}{b^2+\lambda}$$

$$\frac{x}{x^2-a^2} = \frac{y_1}{y}$$

Replace $\frac{dy}{dx} = y_1$ by $\frac{-1}{y_1}$

$$y\,dy = -\left(\frac{x^2-a^2}{x}\right)dx$$

By int.

$$x^2+y^2-2a^2\log x - b = 0$$

5

PART-B

3(a) **Prove that** the relationship between $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$

$$\beta(m,n) = 2\int_0^{\pi/2} \sin^{2m-1}\theta \cos^{2n-1}\theta \, d\theta$$

$$\Gamma(n) = 2\int_0^{\infty} e^{-x^2} x^{2n-1} dx$$

$$\Gamma(m) = 2\int_0^{\infty} e^{-y^2} y^{2m-1} dy$$

$$\Gamma(m+n) = 2\int_0^{\infty} e^{-r^2} r^{2(m+n)-1} dr$$

Take $x = r\cos\theta$, $y = r\sin\theta$,

$dx\,dy = r\,dr\,d\theta$

r varies from 0 to ∞, θ varies from 0 to $\pi/2$

$$\therefore \beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$$

5

(b) **Evaluate:** $\int_0^{\pi/2} \sqrt{\sin\theta}\,d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \pi$

WKT $\int_0^{\pi/2} \sin^p\theta \cos^q\theta \, d\theta = \frac{1}{2}\beta\left(\frac{p+1}{2}, \frac{q+1}{2}\right)$

$$\int_0^{\pi/2} \sqrt{\sin\theta}\,d\theta = \int_0^{\pi/2} \sin^{1/2}\theta \cos^0\theta \, d\theta = \frac{1}{2}\beta\left(\frac{3}{4}, \frac{1}{2}\right)$$

$$\int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \int_0^{\pi/2} \sin^{-1/2}\theta \cos^0\theta \, d\theta = \frac{1}{2}\beta\left(\frac{1}{4}, \frac{1}{2}\right)$$

$$\therefore \int_0^{\pi/2} \sqrt{\sin\theta}\,d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}} d\theta = \pi$$

5

OR		
4(a)	Evaluate : $\int_0^1 \int_{\sqrt{y}}^{2-y} xy\,dx\,dy$	
	$I = \int_0^1 (4y + y^3 - 5y^2)\,dy$ $= \left[\frac{4y^2}{2} + \frac{y^4}{4} - \frac{5y^3}{3}\right]_0^1$ $= \frac{31}{24}.$	5
(b)	Evaluate: $\int_0^1 \int_0^2 \int_1^2 xyz^2\,dz\,dy\,dx$	
	$I = \frac{1}{3}\int_0^1 \int_0^2 7xy\,dy\,dx$ $= \frac{14}{3}\int_0^1 x\,dx$ $= \frac{7}{3}$	5

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(c)	**Find** the oryhogonal trajectories of the family of curves $\frac{x^2}{a^2}+\frac{y^2}{b^2+\lambda}=1$	
	$\frac{x}{a^2} = \frac{-yy_1}{b^2+\lambda}$ $\frac{x}{x^2-a^2} = \frac{y_1}{y}$ Replace $\frac{dy}{dx}=y_1$ by $\frac{-1}{y_1}$ $y\,dy = -\frac{(x^2-a^2)}{x}dx$ By int. $x^2+y^2-2a^2\log x-b=0$	5

PART-B

3(a)	**Prove that** the relationship between $\beta(m,n)=\frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$	
	$\beta(m,n)=2\int_0^{\pi/2}\sin^{2m-1}\theta\cos^{2n-1}\theta\,d\theta$ $\Gamma(n)=2\int_0^{\infty}e^{-x^2}x^{2n-1}dx$ $\Gamma(m)=2\int_0^{\infty}e^{-y^2}y^{2m-1}dy$ $\Gamma(m+n)=2\int_0^{\infty}e^{-r^2}r^{2(m+n)-1}dr$ Take $x=r\cos\theta$, $y=r\sin\theta$, $dx\,dy=r\,dr\,d\theta$ r varies from 0 to ∞, θ varies from 0 to $\pi/2$ $\therefore \beta(m,n)=\frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$	5
(b)	**Evaluate:** $\int_0^{\pi/2}\sqrt{\sin\theta}\,d\theta\times\int_0^{\pi/2}\frac{1}{\sqrt{\sin\theta}}d\theta=\pi$	
	WKT $\int_0^{\pi/2}\sin^p\theta\cos^q\theta\,d\theta=\frac{1}{2}\beta\left(\frac{p+1}{2},\frac{q+1}{2}\right)$ $\int_0^{\pi/2}\sqrt{\sin\theta}\,d\theta=\int_0^{\pi/2}\sin^{1/2}\theta\cos^0\theta\,d\theta=\frac{1}{2}\beta\left(\frac{3}{4},\frac{1}{2}\right)$ $\int_0^{\pi/2}\frac{1}{\sqrt{\sin\theta}}d\theta=\int_0^{\pi/2}\sin^{-1/2}\theta\cos^0\theta\,d\theta=\frac{1}{2}\beta\left(\frac{1}{4},\frac{1}{2}\right)$ $\therefore\int_0^{\pi/2}\sqrt{\sin\theta}\,d\theta\times\int_0^{\pi/2}\frac{1}{\sqrt{\sin\theta}}d\theta=\pi$	5

	OR	
4(a)	Evaluate : $\int_0^1 \int_{\sqrt{y}}^{2-y} xy\, dx\, dy$	
	$I = \int_0^1 (4y + y^3 - 5y^2)\, dy$ $= \left[\frac{4y^2}{2} + \frac{y^4}{4} - \frac{5y^3}{3}\right]_0^1$ $= \frac{31}{24}$	5
(b)	Evaluate: $\int_0^1 \int_0^2 \int_1^2 xyz^2\, dz\, dy\, dx$	
	$I = \frac{1}{3} \int_0^1 \int_0^2 7xy\, dy\, dx$ $= \frac{14}{3} \int_0^1 x\, dx$ $= \frac{7}{3}$	5

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29/12/2023

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