KANNUR UNIVERSITY

FOUR YEAR UNDERGRADUATE PROGRAMME

SYLLABUS

MATHEMATICS
HONOURS/HONOURS WITH RESEARCH

(Effective from 2024 admissions)

KANNUR UNIVERSITY
VISION AND MISSION STATEMENTS

Vision

To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargode and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher education and to cater to the modern notions of equity, social justice and merit in all educational endeavours.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

INTRODUCTION

Kannur University – Four Year Undergraduate Programme: Backdrop and Context

The implementation of the Four-Year Undergraduate Programme (FYUGP) has been driven by the pressing need to address contemporary challenges ensuring responsive changes to the evolving needs of students, industry, and society at large. Recognizing the curriculum as the cornerstone of any education system, it requires regular refinement to align with evolving socio-economic factors. Higher education must provide students with practical and technical skills relevant to their fields of interest, necessitating the development of a job-oriented curriculum. Despite significant increases in access and expansion of higher education over the years, concerns persist regarding the quality and relevance of educational outcomes, particularly in terms of employability skills. As the world becomes increasingly interconnected, our education system must evolve to instill 21st-century skills, enabling students not only to survive but to thrive in this dynamic environment. Moreover, there is a
growing need for higher education institutions to embrace social responsibility and contribute to the development of a knowledge society capable of driving sustainable development through innovation. With the central objective of fostering a robust knowledge society to support a knowledge economy, the Government of Kerala has initiated steps to reform higher education. Accordingly, three commissions were established to suggest reforms in higher education policy, legal and regulatory mechanisms, and evaluation and examination systems. It is within this context that a comprehensive reform of the undergraduate curriculum has been proposed, leading to the restructuring of the Four-Year Undergraduate Programme.

KANNUR UNIVERSITY

PROGRAMME OUTCOMES

PO1: **Critical Thinking and Problem-Solving**-Apply critical thinking skills to analyze information and develop effective problem-solving strategies for tackling complex challenges.

PO2: **Effective Communication and Social Interaction**-Proficiently express ideas and engage in collaborative practices, fostering effective interpersonal connections.

PO3: **Holistic Understanding**-Demonstrate a multidisciplinary approach by integrating knowledge across various domains for a comprehensive understanding of complex issues.

PO4: **Citizenship and Leadership**-Exhibit a sense of responsibility, actively contribute to the community, and showcase leadership qualities to shape a just and inclusive society.

PO5: **Global Perspective**-Develop a broad awareness of global issues and an understanding of diverse perspectives, preparing for active participation in a globalized world.

PO6: **Ethics, Integrity and Environmental Sustainability**-Uphold high ethical standards in academic and professional endeavors, demonstrating integrity and ethical decision-making. Also acquire an understanding of environmental issues and sustainable practices, promoting responsibility towards ecological well-being.

PO7: **Lifelong Learning and Adaptability**-Cultivate a commitment to continuous selfdirected learning, adapting to evolving challenges, and acquiring knowledge throughout life.

PREFACE

This syllabus serves as a roadmap for academic journey, outlining the courses and objectives designed to cultivate mathematical proficiency and intellectual curiosity.

Mathematics is not merely a collection of techniques and formulae; it is a language for expressing and understanding patterns, structures, and relationships in the world around us. It is the universal language which forms the bedrock of scientific inquiry and technological advancement. As a student embark on this educational voyage, he/she will explore the beauty and power of mathematical ideas while developing problem-solving skills that are invaluable in both academic and real-world contexts.

This program is structured to provide a comprehensive foundation in core mathematical disciplines, including Algebra, Number theory, Calculus, Geometry, Abstract Algebra, Linear Algebra, Analysis, Topology and Discrete Mathematics. Through a combination of theoretical study and practical applications, students can deepen their understanding of fundamental concepts and sharpen their ability to apply them creatively to solve complex problems.

In addition to core courses, students have the opportunity to tailor their studies through a variety of elective options, allowing to pursue specialized interests in areas such as Numerical Analysis, Optimization, Cryptography, Fuzzy Mathematics and more, which are necessary to instill 21^{st} century skills.

Also, there is provision to align with interests and career aspirations. Whether passion lies in pure mathematics, applied mathematics, or interdisciplinary fields, one can find courses from Multidisciplinary/Value added/Skill Enhancement courses to suit his/her academic trajectory. Further, assignments, seminars and project work promote self-study and develop research mind in students.

The UG Board of Studies in Mathematics puts forward this syllabus for Four Year Under-Graduate Programme in Mathematics for implementation from 2024 onwards. We thank all those who helped us by giving critical suggestions for improvement.

Dr. C.P. Santhosh
Chairman
UG Board of Studies in Mathematics
Kannur University

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Understand basic concepts and tools of Mathematical logic, Set theory, Number theory, Geometry, Calculus, Vector calculus, Algebra, Abstract structures, Linear Algebra, Laplace transforms, Differential equations, Numerical Analysis, Fourier series, Real Analysis, Complex Analysis, Topology and Measure theory.

PSO 2: Develop abstract reasoning and critical thinking skills necessary for advanced mathematical study and applications in various fields.

PSO 3: Develop proficiency in defining, formulating and solving problems by applying appropriate mathematical methods and principles.

PSO 4: Formulate real world problems into mathematical models and find solutions.

PSO 5: Develop proficiency in using mathematical softwares and programming languages.

PSO 6: Understand the interdisciplinary nature of mathematics and apply mathematical concepts and techniques to solve problems in other sciences.

PSO 7: Get equipped with basic research skills.

KANNUR UNIVERSITY

FOUR YEAR UNDERGRADUATE PROGRAMME

MATHEMATICS HONOURS/HONOURS WITH RESEARCH

PROGRAMME STRUCTURE

B.Sc. Mathematics Pathway Courses (2024 admission onwards)						
Sl. No.	***Level***	***Course Code***	***Semester***	***Name of course***	***Credits***	***Major Pathway Courses***
1	100-199	KU1DSCMAT101	I	Calculus I	4	1
2	100-199	KU1DSCMAT111	I	Basic Mathematics I	4	
3	100-199	KU1DSCMAT112	I	Calculus and Matrix Algebra	4	
4	100-199	KU1DSCMAT113	I	Functions, Calculus and Matrices	4	
5	100-199	KU1DSCMAT114	I	Mathematical Economics I	4	
6	100-199	KU1DSCMAT115	I	Algebra, Differential Calculus and Probability	4	
7	100-199	KU1DSCMAT116	I	Calculus and Coordinate Systems	4	
8	100-199	KU1DSCMAT117	I	Calculus and Matrix Algebra I	4	
9	100-199	KU1DSCMAT118	I	Probability Theory I	4	
10	100-199	KU1DSCMAT119	I	Foundations of Mathematics I	4	
11	100-199	KU2DSCMAT101	II	Calculus II	4	2
12	100-199	KU2DSCMAT111	II	Basic Mathematics II	4	
13	100-199	KU2DSCMAT112	II	Differential Calculus, Curve Fitting and Coordinate Systems	4	
14	100-199	KU2DSCMAT113	II	Set theory, Number theory, Integral Calculus and Fourier Series	4	
15	100-199	KU2DSCMAT114	II	Mathematical Economics II	4	
16	100-199	KU2DSCMAT115	II	Linear Algebra, Differential Calculus and Vectors	4	
17	100-199	KU2DSCMAT116	II	Multivariable Calculus	4	

18	100-199	KU2DSCMAT117	II	Calculus and Matrix Algebra II	4	
19	100-199	KU2DSCMAT118	II	Probability Theory II	4	
20	100-199	KU2DSCMAT119	II	Foundations of Mathematics II	4	
21	200-299	KU3DSCMAT201	III	Algebra	4	3
22	200-299	KU3DSCMAT202	III	Coordinate Systems and Multiple Integrals	4	4
23	200-299	KU3DSCMAT211	III	Differential Equations, Laplace Transforms, Linear Programming and Numerical Methods	4	
24	200-299	KU3DSCMAT212	III	Basic Mathematical methods	4	
25	200-299	KU3DSCMAT213	III	Graph theory, Linear programming and Numerical Methods	4	
26	200-299	KU3DSCMAT214	III	Applied Differential and Difference Equations in Economic Analysis	4	
27	200-299	KU3DSCMAT215	III	Differential Equations, Laplace Transforms and Fourier series	4	
28	200-299	KU3DSCMAT216	III	Transforms, Linear Algebra and Partial Differential Equations	4	
29	200-299	KU3DSCMAT217	III	Multiple Integrals, Differential Equations and Numerical Methods	4	
30	200-299	KU4DSCMAT201	IV	Analytic Geometry	4	5
31	200-299	KU4DSCMAT202	IV	Number Theory and Complex Numbers	4	6
32	200-299	KU4DSCMAT203	IV	Ordinary Differential Equations and Laplace Transforms	4	7
33	300-399	KU5DSCMAT301	V	Real Analysis I	4	8
34	300-399	KU5DSCMAT302	V	Basic Abstract Algebra	4	9
35	300-399	KU5DSCMAT303	V	Matrices, Fourier Series and Partial Differential Equations	4	10
36	300-399	KU5DSEMAT301	V	Numerical Analysis	4	11/12 Elective (a)
37	300-399	KU5DSEMAT302	V	Fuzzy Mathematics	4	11/12 Elective (b)
38	300-399	KU5DSEMAT303	V	Programming in Python	3+1	11/12 Elective (c)
39	300-399	KU6DSCMAT301	VI	Vector Calculus	4	13
40	300-399	KU6DSCMAT302	VI	Real Analysis II	4	14
41	300-399	KU6DSCMAT303	VI	Complex Analysis	4	15
42	300-399	KU6DSEMAT301	VI	Graph Theory	4	16/17 Elective (a)
43	300-399	KU6DSEMAT302	VI	Operations Research	4	16/17 Elective (b)
44	300-399	KU6DSEMAT303	VI	Cryptography	4	16/17 Elective (c)

45	400-499	KU6INTMAT301	VI	Internship/Apprenticeship/Field Trip	2	18
46	400-499	KU7DSCMAT401	VII	Advanced Abstract Algebra	4	19
47	400-499	KU7DSCMAT402	VII	Mathematical Analysis	4	20
48	400-499	KU7DSCMAT403	VII	Basic Topology	4	21
49	400-499	KU7DSCMAT404	VII	Linear Algebra	4	22
50	400-499	KU7DSCMAT405	VII	Advanced Ordinary Differential Equations	4	23
51	400-499	KU8DSCMAT401	VIII	Advanced Topology	4	24
52	400-499	KU8DSCMAT402	VIII	Advanced Linear Algebra	4	25
53	400-499	KU8DSCMAT403	VIII	Measure Theory	4	26
54	400-499	KU8DSEMAT401	VIII	Research Methodology in Mathematics	4	27/28/29 Elective (a)
55	400-499	KU8DSEMAT402	VIII	Analytic Number Theory	4	27/28/29 Elective (b)
56	400-499	KU8DSEMAT403	VIII	Advanced Optimization Methods	4	27/28/29 Elective (c)
57	400-499	KU8DSEMAT404	VIII	MOOC/Online course I	4	27/28/29 Elective (d)
58	400-499	KU8DSEMAT405	VIII	MOOC/Online course II	4	27/28/29 Elective (e)
59	400-499	KU8CIPMAT406	VIII	MOOC/Online course III	4	27/28/29 Elective (f)
60	400-499	KU8CIPMAT 400	VIII	Capstone Internship Project in Honours Programme in Mathematics	8	30(a)
61	400-499	KU8PHRMAT400	VIII	Project in Honours with Research Programme in Mathematics	12	30(b)

*Courses with codes of the form KU*DSCMAT*12 are preferable for Chemistry Major students.*

*Courses with codes of the form KU*DSCMAT*13 are preferable for Computer Science Major students.*

*Courses with codes of the form KU*DSCMAT*15 are preferable for Electronics Major students.*

*Courses with codes of the form KU*DSCMAT*16 are preferable for Physics Major students.*

*Courses with codes of the form KU*DSCMAT*17 are preferable for Statistics Major students.*

General Foundation Courses offered by Department of Mathematics						
Sl. No.	***Level***	***Course Category***	***Course Code***	***Semester***	***Name of Course***	***Credits***
1	100-199	MDC	KUIMDCMAT101	I	Mathematics in Real Life	3
2	100-199	MDC	KUIMDCMAT102	I	Business Mathematics	3
3	100-199	MDC	KUIMDCMAT103	I	Matrix Theory	3
4	100-199	MDC	KU2MDCMAT101	II	Mathematical Reasoning	3
5	100-199	MDC	KU2MDCMAT102	II	Mathematics for Social Science	3
6	100-199	MDC	KU2MDCMAT103	II	Vector Algebra	3
7	200-299	MDC		III	Kerala Studies	3
8	200-299	VAC	KU3VACMAT201	III	Quantitative Arithmetic	3
9	200-299	VAC	KU3VACMAT202	III	Mathematical Logic	3
10	200-299	VAC	KU4VACMAT201	IV	Mathematical Reasoning	3
11	200-299	VAC	KU4VACMAT202	IV	Graph Theory	3
12	200-299	VAC	KU4VACMAT203	IV	LaTeX	2 + 1
13	200-299	VAC	KU4VACMAT204	IV	Mathematics in Real Life Through GoeGebra	2 + 1
14	200-299	SEC	KU4SECMAT201	IV	Geogebra-Based Mathematical Visualisations and Applications	2 + 1
15	300-399	SEC	KU5SECMAT301	V	LaTeX	2 + 1
16	300-399	SEC	KU6SECMAT301	VI	Scilab	2 + 1
17	300-399	SEC	KU6SECMAT302	VI	Programming in Python	2 + 1

SEMESTERWISE DISTRIBUTION OF COURSES FOR FOUR YEAR UG PROGRAMME (FYUGP) MATHEMATICS

(2024 ADMISSION ONWARDS)

SEMESTER 1

No	Title	Hours/ week	Credit	CE	ESE	Total marks
1	AEC 1 (English)	3	3	25	50	75
2	AEC 2 (Additional Language)	3	3	25	50	75
3	MDC 1	3	3	25	50	75
4	DSC (Major)	4	4	30	70	100
5	DSC (Minor 1)	4	4	30	70	100
6	DSC (Minor 2)	4	4	30	70	100
	Total credits		21			

SEMESTER II

No	Title	Hours/week	Credit	CE	ESE	Total marks
1	AEC 3 (English)	3	3	25	50	75
2	AEC 4 (Additional Language)	3	3	25	50	75
3	MDC 2	3	3	25	50	75
4	DSC (Major)	4	4	30	70	100
5	DSC (Minor 1)	4	4	30	70	100
6	DSC (Minor 2)	4	4	30	70	100
	Total credits		21			

SEMESTER III

No	Title	Hours/w eek	Credit	CE	ESE	Total marks
1	MDC 3	3	3	25	50	75
2	VAC 1	3	3	25	50	75
3	DSC (Major)	4	4	30	70	100
4	DSC (Major)	4	4	30	70	100
5	DSC (Minor 1)	4	4	30	70	100
6	DSC (Minor 2)	4	4	30	70	100
	Total credits		22			

SEMESTER IV

No	Title	Hours/week	Credit	CE	ESE	Total marks
1	SEC 1	3	3	25	50	75
2	VAC 2	3	3	25	50	75
3	VAC 3	3	3	25	50	75
4	DSC (Major)	4	4	30	70	100
5	DSC (Major)	4	4	30	70	100
6	DSC (Major)	4	4	30	70	100
	Total credits		21			

SEMESTER V

No	Title	Hours/ week	Credit	CE	ESE	Total marks
1	SEC 2	3	3	25	50	75
2	DSC (Major)	4	4	30	70	100
3	DSC (Major)	4	4	30	70	100
4	DSC (Major)	4	4	30	70	100
5	DSE (Major Elective)	4	4	30	70	100
6	DSE (Major Elective)	4	4	30	70	100
	Total credits		23			

SEMESTER VI

No	Title	Hours/ week	Credit	CE	ESE	Total marks
1	SEC 3	3	3	25	50	75
2	DSC (Major)	4	4	30	70	100
3	DSC (Major)	4	4	30	70	100
4	DSC (Major)	4	4	30	70	100
5	DSE (Major Elective)	4	4	30	70	100
6	DSE (Major Elective)	4	4	30	70	100
7	Internship	2	2			
	Total credits		25			

EXIT WITH UG DEGREE/PROCEED TO FOURTH YEAR WITH 133 CREDITS

17 Major course *:17 x 4 = 68 credits*

6 minor course *:6 x 4 = 24 credits*

13 foundation courses (AEC, SEC, VAC, MDC) *:13 x 3 = 39 credits*

1 Internship *:2 x1 = 2 credits*

Total ***: 133 credits***

SEMESTER VII

No	Title	Hours/ week	Credit	CE	ESE	Total marks
1	DSC (Major)	4	4	30	70	100
2	DSC (Major)	4	4	30	70	100
3	DSC (Major)	4	4	30	70	100
4	DSC (Major)	4	4	30	70	100
5	DSC (Major)	4	4	30	70	100
	Total credits		20			

SEMESTER VIII

	Toatal Credit	Total marks for CE	Total marks for ESE	Total marks
Project and Courses as per the FYUGP Regulation	24	180	420	600

DISCIPLINE SPECIFIC COURSES

KU1DSCMAT101: CALCULUS I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT101	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce the notion of limits, continuity, derivatives and integrals and to discuss applications of differentiation and integration.

Course Prerequisite

Functions

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend trigonometric functions, exponential functions, inverse functions, logarithmic function and hyperbolic functions	Understand
2	Apply Exponential growth and decay in Finance and in Radio active decay	Apply
3	Understand the notion of limit and limit laws	Understand
4	Understand continuity of a function	Understand
5	Comprehend the notion of derivative of a function and differentiation rules	Understand
6	Comprehend the indefinite and definite integrals	Understand

7	Apply the notion of definite integrals to find area between curves and arc length	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2						✓	
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Functions and Limits**		14
	1	**Functions**	
		a) Trigonometric functions	
		b) Exponential functions	
		c) Inverse functions and logarithms	
		d) Hyperbolic functions (Definition and identities only)	
	2	**Limits**	
		Limit of a function and limit laws	
II	**Continuity and Differentiation of functions**		

	1	**Continuity**	14
	2	**Differentiation**	
		a) The derivative as a function	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain rule	
		e) Implicit differentiation	
		f) Derivatives of inverse functions and logarithms	
		g) Derivatives of inverse trigonometric functions	
		h) Derivatives of hyperbolic functions	
III	**Integration**		14
	1	**Indefinite integrals**	
		a) Integral of a function	
		b) The study of Integral Calculus	
		c) Indefinite integral	
		d) Indefinite integrals and the substitution method	
		e) Integration by parts	
		f) Trigonometric substitutions	
		g) Integration of rational functions by partial fractions	
	2	**Definite integrals**	
IV	**Applications of integration**		**13**
	1	a) Geometric interpretation of definite integral (without proof)	
		b) Substitution and Area between curves	
		c) Arc length	

<table>
<tr><td rowspan="6">V</td><td>Teacher Specific Module</td><td rowspan="6">5</td></tr>
<tr><td>Directions</td></tr>
<tr><td>Graphs of functions mentioned in Unit 1 in Module I</td></tr>
<tr><td>Precise definition of limit, One-sided limit (Sections 2.3, 2.4)</td></tr>
<tr><td>Riemann sums, its geometric meaning and definite integral</td></tr>
<tr><td>Any topic related to Module I, II, III & IV</td></tr>
</table>

Essential Readings

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education
2. S. Narayan and P.K. Mittal , Integral Calculus (Revised Edition), S. Chand & Company Ltd.

Reference Distribution

<table>
<tr><th>Module</th><th>Unit</th><th>Reference No.</th><th>Sections</th><th>Remarks</th></tr>
<tr><td rowspan="2">I</td><td>1</td><td>1</td><td>Sections 1.3, 1.5, 1.6, 7.3, 2.2</td><td>Only quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3</td></tr>
<tr><td>2</td><td>1</td><td>Section 2.2</td><td></td></tr>
<tr><td rowspan="2">II</td><td>1</td><td>1</td><td>Section 2.5</td><td></td></tr>
<tr><td>2</td><td>1</td><td>Sections 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 7.3</td><td></td></tr>
<tr><td rowspan="3">III</td><td rowspan="2">1</td><td>2</td><td>For 1(a), (b) & (c), Sections 1.1, 1.2, 1.3, 1.4 & 1.5</td><td></td></tr>
<tr><td>1</td><td>For 1(d), (e), (f) & (g), Sections 5.5, 8.1, 8.3 & 8.4</td><td></td></tr>
<tr><td>2</td><td>2</td><td>Sections 1.6, 1.7</td><td></td></tr>
<tr><td rowspan="2">IV</td><td rowspan="2">1</td><td>2</td><td>For 1(a), Section 1.8</td><td></td></tr>
<tr><td>1</td><td>For 1(b) &(c), Sections 5.6, 6.3</td><td></td></tr>
</table>

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10th edition , Willey

2. Higher Engineering Mathematics, B.S. Grewal (43rd edition), Khanna Publishers
3. S Narayan and P.K Mittal , Differential calculus, Revised Edition, S. Chand & Company Ltd
4. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Willey

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT111
BASIC MATHEMATICS I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT111	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This foundational math course for computer applications covers essential concepts like functions, limits and continuity, differentiation, integration, and matrix basics. It's crucial as it forms the mathematical groundwork for algorithm design, data analysis, and various computational techniques used extensively in computer applications..

Course Prerequisite

Functions, matrices, basic operations of matrices, determinant of a matrix.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend trigonometric functions, exponential functions, inverse functions, logarithmic function and hyperbolic functions	Understand
2	Understand the notion of limit, limit laws and continuity of a function	Understand
3	Apply differentiation rules, integration techniques, and matrix operations.	Apply
4	Comprehend the notion of derivative of a function differentiation rules and partial derivatives	Understand

5	Comprehend the indefinite and definite integrals	Understand
6	Evaluate rank of matrices, and solutions using Gauss-Jordan method.	Evaluate

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2						✓	
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I		**Functions and Limits**	13
	1	**Functions**	
		a) Trigonometric functions	
		b) Exponential functions	
		c) Inverse functions and logarithms	
		d) Hyperbolic functions	
		e) Functions of Several Variables	
	2	**Limits**	
		a) Limit of a function and limit laws	

		b) Limits and Continuity in Higher Dimensions	
II	**Continuity and Differentiation of functions**		**14**
	1	**Continuity**	
	2	**Differentiation**	
		a) The derivative as a function	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain rule	
		e) Implicit differentiation	
		f) Derivatives of inverse functions	
		g) Derivatives of inverse trigonometric functions	
		h) Partial Derivatives and Chain Rule	
III	**Integration**		**14**
	1	**Indefinite integrals**	
		a) Integral of a function	
		b) The study of Integral Calculus	
		c) Indefinite integral	
		d) Indefinite integrals and the substitution method	
		e) Integration by parts	
		f) Trigonometric substitutions	
		g) Integration of rational functions by partial fractions	
	2	**Definite integrals**	
		a) Definite integral	
		b) Geometric interpretation of definite integral (without proof)	
IV	**Matrix basics**		**14**
	1	a) Transpose of a matrix, Adjoint of a square matrix, Inverse of a matrix.	

		b) Rank of a matrix, Elementary transformation of a matrix, Equivalent matrix, Elementary matrices, Gauss-Jordan method of finding the inverse	
V	**Teacher Specific Module**		**5**
	Directions		
	Graphs of functions mentioned in Unit 1 in Module I		
	Precise definition of limit, One-sided limit (Sections 2.3, 2.4)		
	Riemann sums, its geometric meaning and definite integral		
	Normal form of a matrix.		
	Any topic related to Module I, II, III & IV		

Essential Readings

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education
2. S. Narayan and P.K. Mittal , Integral calculus, Revised Edition, S. Chand & Company Ltd.
3. Advanced Higher Engineering Mathematics (42nd edition), B.S. Grewal, Khanna Pub.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 1.3, 1.5, 1.6, 7.3, 2.2,14.1	*Quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3.* *Graphs, Level Curves, and Contours of Functions of Two Variables and computer Graphing from section 14.1 excluded*
	2	1	Section 2.2 ,14.2	*Proof of all theorems from section 14.2 excluded*

II	1	1	Section 2.5	
	2	1	Sections 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9 ,14.3,14.4	*Proof of all theorems from sections 14.3 and 14.4 are excluded*
III	1	2	For 1(a), (b) & (c), Sections 1.1, 1.2, 1.3, 1.4 & 1.5	
		1	For 1(d), (e), (f) & (g), Sections 5.5, 8.1, 8.3 & 8.4	
	2	2	Sections 1.6, 1.7, 1.8	
IV	1	3	2.6	
	2	3	2.7	*Exclude 2.7 (7)*

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10^{th} edition , Willey
2. Higher Engineering Mathematics, B.S. Grewal (43^{rd} edition), Khanna Publishers
3. S Narayan and P.K Mittal , Differential calculus, Revised Edition, S. Chand & Company Ltd
4. E. Kreyszig, Advanced Engineering Mathematics (10^{th} edition), Willey
5. Richard Bronson, Schaum's outline of Theory and Problems of Matrix Operations, Schum's outline series, The MaGraw-Hill Campanies

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT112
CALCULUS AND MATRIX ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT112	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to discuss limits, continuity, derivative and inverse, rank, eigenvalues and eigenvectors of a matrix.

Course Prerequisite

Functions, operations of matrices, determinant of a square matrix.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend trigonometric functions, exponential functions, inverse functions, logarithmic function and hyperbolic functions	Understand
2	Apply Exponential growth and decay in Finance and in Radio active decay	Apply
3	Understand the notion of limit and limit laws	Understand
4	Understand continuity of a function	Understand
5	Comprehend the notion of derivative of a function and differentiation rules	Understand
6	Comprehend the indefinite and definite integrals	Understand

7	Determine inverse, rank, eigenvalues and eigenvectors of a matrix	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2						✓	
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Functions and Limits**		13
	1	**Functions**	
		a) Trigonometric functions	
		b) Exponential functions	
		c) Inverse functions and logarithms	
		d) Hyperbolic functions (Definition and identities only)	
	2	**Limits**	
		Limit of a function and limit laws	
II	**Continuity and Differentiation of functions**		

	1	**Continuity**	14
	2	**Differentiation**	
		a) The derivative as a function	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain rule	
		e) Implicit differentiation	
		f) Derivatives of inverse functions and logarithms	
		g) Derivatives of inverse trigonometric functions	
		h) Derivatives of hyperbolic functions	
III	**Integration**		**14**
	1	**Indefinite integrals**	
		a) Integral of a function	
		b) The study of Integral Calculus	
		c) Indefinite integral	
		d) Indefinite integrals and the substitution method	
		e) Integration by parts	
		f) Trigonometric substitutions	
		g) Integration of rational functions by partial fractions	
	2	**Definite integrals**	
		a) Definite integral	
		b) Geometric interpretation of definite integral (without proof)	
IV	**Matrices**		**14**
	1	**Inverse of matrix**	
		a) Inverse by Gauss-Jordan elimination	
		b) Inverse by determinants (or adjoint)	
	2	**Rank of a matrix**	

		(a) Rank of a matrix	
		(b) Elementary transformations of a matrix	
		(c) Invariance of rank	
		(d) normal form of matrix	
	3	**Eigenvalues and eigenvectors**	
V	**Teacher Specific Module**		**5**
	Directions		
	Graphs of functions mentioned in Unit 1 in Module I		
	Precise definition of limit, One-sided limit (Sections 2.3, 2.4)		
	Riemann sums, its geometric meaning and definite integral		
	Any topic related to Module I, II, III & IV		

Essential Readings

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education
2. S. Narayan and P.K. Mittal , Integral calculus (Revised Edition), S. Chand & Company Ltd.
3. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Willey
4. S. Narayan and P.K. Mittal, A Text Book of Matrices (10th edition), S. Chand & Company Ltd.

Reference Distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 1.3, 1.5, 1.6, 7.3, 2.2	*Only quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3*
	2	1	Section 2.2	
II	1	1	Section 2.5	

	2	1	Sections 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 7.3	
III	1	2	For 1(a), (b) & (c), Sections 1.1, 1.2, 1.3, 1.4 & 1.5	
		1	For 1(d), (e), (f) & (g), Sections 5.5, 8.1, 8.3 & 8.4	
	2	2	Sections 1.6, 1.7, 1.8	
IV	1	3	Section 7.8	*Theorem 3 and proof of Theorem 4 are omitted*
	2	4	Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8	*All proofs are omitted*
	3	3	Section 8.1	

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10^{th} edition , Willey
2. B.S. Grewal, Higher Engineering Mathematics (43^{rd} edition), Khanna Publishers
3. S Narayan and P.K Mittal , Differential calculus (Revised Edition), S. Chand & Company Ltd.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KUIDSCMAT113
FUNCTIONS, CALCULUS AND MATRICES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	DSC	100	KUIDSCMAT113	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This foundational mathematics course for computer science covers essential concepts like functions, limits and continuity, differentiation, integration, and matrix basics. It's crucial as it forms the mathematical groundwork for algorithm design, data analysis, and various computational techniques used extensively in computer science.

Course Prerequisite

Functions, matrix, basic matrix operations, determinant of matrix.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Recall trigonometric functions, exponential functions, and logarithms.	Remember
2	Comprehend limit laws, continuity and differentiation concepts	Understand
3	Comprehend differentiation rules, integration techniques, and matrix operations.	Understand

4	Understand limit properties, continuity conditions, and matrix transformations.	Understand
5	Evaluate definite integrals	Understand
6	Determine ranks of matrices	Understand
7	Find inverse of a matrix using Gauss-Jordan method.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3			✓				
CO 4	✓						
CO 5			✓				
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I	**Functions and Limits**		**13**
	1	**Functions**	
		a) Trigonometric functions	
		b) Exponential functions	
		c) Inverse functions and logarithms	

		d) Hyperbolic functions	
	2	**Limits**	
		Limit of a function and limit laws	
II	**Continuity and Differentiation of functions**		**14**
	1	**Continuity**	
	2	**Differentiation**	
		a) The derivative as a function	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain rule	
		e) Implicit differentiation	
		f) Derivatives of inverse functions	
		g) Derivatives of inverse trigonometric functions	
III	**Integration**		14
	1	Table of elementary integral	
	2	Definite integral	
	3	Two important properties of definite integrals	
	4	Integration by substitution	
	5	Three important forms of integrals	
IV	**Matrix basics**		**14**
	1	Related matrices: Transpose of a matrix, Adjoint of a square matrix, Inverse of a matrix.	
	2	Rank of a matrix, Elementary transformation of a matrix, Equivalent matrix, Elementary matrices, Gauss-Jordan method of finding the inverse	
V	**Teacher specific module**		**5**
	Directions		
	Graphs of functions mentioned in Unit 1 in Module I		

	Precise definition of limit, One-sided limit (Sections 2.3, 2.4)	
	Any topic related to Module I, II, III & IV	

Essential Readings

1. Thomas' Calculus:Early Transcendentals (12th edition), G.B. Thomas Jr., M.D. Weir and J.R. Hass, Pearson Education
2. Integral Calculus, Santhi Narayanan and P.K. Mittal, S. Chand and Co.
3. Advanced Higher Engineering Mathematics (42nd edition), B.S. Grewal, Khanna Pub

Reference Distribution

Module	Unit	Reference No.	Page Nos.	Remarks
I	1	1	Sections 1.3, 1.5, 1.6, 7.3, 2.2	*Quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3*
	2	1	Section 2.2	
II	1	1	Section 2.5	
	2	1	Sections 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9	
III	1	2	1.4	
	2	2	1.6	
	3	2	1.7	
	4	2	2.2	
	5	2	2.3	
V	1	3	2.6	
	2	3	2.7	*Exclude 2.7 (7)*

Suggested Readings

1. Calculus, 10th edition, H Anton, Bivens and Davis, Willey

2. Higher Engineering Mathematics, B.S. Grewal (43rd edition), Khanna Publishers
3. Differential calculus, Revised Edition, S Narayan and P.K Mittal, S. Chand & Company Ltd
4. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Willey
5. Textbook of Matrices, Shanti Narayan and P.K. Mittal, S. Chand & Co.
6. Theory of and Problems of Matrices, Frank Ayres JR, Schaum's Outline Series, McGraw- Hill Book Company.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT114: MATHEMATICAL ECONOMICS I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT114	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces fundamental concepts in mathematical economics, covering functions, economic applications of graphs and equations, limits, continuity, differentiation, applications of derivatives in economics.

Course Prerequisite

Proficiency in basic algebraic operations and a basic understanding of economic principles.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the properties and applications of exponent	Understand
2	Comprehend the concept of functions and their graphical representations.	Understand
3	Interpret and analyse isocost lines to understand production cost constraints	Understand
4	Apply supply and demand analysis to analyse market equilibrium and pricing.	Apply
5	Comprehend the notion of derivative of a function and differentiation rules	Understand

6	Apply derivatives to optimize economic functions for maximum efficiency or profit.	Apply
7	Apply optimization techniques to maximize or minimize economic functions.	Apply
8	Understand and interpret the relationship among total, marginal, and average concepts in economic analysis.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3				✓			
CO 4			✓	✓			
CO 5	✓						
CO 6			✓	✓			
CO 7			✓	✓			
CO8	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Functions**	14
	1	**Functions**	
		a) Exponents	
		b) Polynomials	
		c) Equations: Linear and Quadratic	
		d) Simultaneous Equations	

		e) Functions	
		f) Graphs, Slopes and Intercepts	
II	1	**Economic Application of Graphs and Equations**	**13**
		a) Isocost Lines	
		b) Supply and Demand Analysis	
		c) Income Determination Models	
		d) *IS-LM* Analysis	
III	1	**The Derivatives and the Rules of Differentiation**	**14**
		a) Limits	
		b) Continuity	
		c) The derivative	
		d) Differentiability and continuity	
		e) Derivative Notation	
		f) Rules of Differentiation	
		g) Higher order derivative	
		h) Implicit differentiation	
IV	**Application of Derivatives in Economics**		**14**
	1	a) Increasing and Decreasing function	
		b) Concavity and Convexity	
		c) Relative Extrema	
		d) Inflection Points	
		e) Optimization of functions	
		f) Successive-Derivatives Test for Optimization	
		g) Marginal Concepts	
		h) Optimizing Economic Functions	
		i) Relationship among Total, Marginal and Average Concepts	
V	**Teacher Specific Module**		**5**
	Directions		
	1.Multivariable Functions		

	1	a) Functions of Severable Variables, Partial Derivatives, Rules of Partial differentiation, Second Order partial Derivatives	
		b) Optimization of Multivariable Functions	
		c) Implicit and Inverse function Rules	
	2	**Application Of Multivariable Functions in Economics**	
		a)Marginal Productivity	
		b)Income Differentiation Multipliers and Comparative Statics	
		c)Income and Cross Price Elasticities of Demand	
		Any topic related to Module I, II, III & IV	

Essential Reading

1. Edward T. Dowling, "Introduction to Mathematical Economics", Third Edition, Schaum's Outline Series, McGraw-Hill International Edition.

Reference Distribution

Module	**Unit**	**Reference No.**	**Chapter**	**Remarks**
I	1	1	Chapter 1	
II	1	1	Chapter 2	
III	1	1	Chapter 3	*Section 3.5 and Derivation of the rules of differentiation are excluded*
IV	1	1	Chapter 4	

Suggested Readings

1. Srinath Barauh (2010). "Basic Mathematics and Its Application in Economics." Amanad, New Delhi.
2. Peter J. Hammond & Knut Sydsaeter (2010). "Mathematics for Economic Analysis." Pearson.
3. Allen R.G.D (1956). "Mathematical Analysis for Economists." Macmillan.
4. Yamane, Taro (2004). "Mathematics for Economists: An Elementary Survey." PHI, New Delhi.
5. Chiang, A.C (1988). "Fundamental Methods of Mathematical Economics." McGraw Hill.

6. Anton, H., Bivens, I., & Davis, S. (2012). "Calculus" (10th ed.). Wiley.
7. Grewal, B. S. (2015). "Higher Engineering Mathematics" (43rd ed.). Khanna Publishers.
8. Narayan, S., & Mittal, P. K. (2014). "Differential Calculus" (Revised ed.). S. Chand & Company Ltd.
9. Kreyszig, E. (2011). "Advanced Engineering Mathematics" (10th ed.). Wiley.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT115
ALGEBRA, DIFFERENTIAL CALCULUS AND PROBABILITY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT115	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce the notion matrices, inverse of a matrix, of limits, continuity, derivatives and probability.

Course Prerequisite

Functions

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend matrices and inverses of matrices	Understand
2	Comprehend trigonometric functions, exponential functions, inverse functions, logarithmic function and hyperbolic functions	Understand
3	Apply Exponential growth and decay in Finance and in Radio active decay	Apply
4	Understand the notion of limit and limit laws	Understand
5	Understand continuity of a function	Understand
6	Comprehend the notions of permutation, combination and probability and addition law of probability	Understand

7	Comprehend the indefinite and definite integrals	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2						✓	
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Matrices**		14
	1	**Matrix**	
		(a) General concepts and notations, Vectors, Equality of matrices, Addition and scalar multiplication of matrices	
		(b) Matrix multiplication, Transposition, Symmetric and skew-symmetric matrices, Unit matrix	
	2	**Rank of a matrix**	
		(a) Linear independence	
		(b) Rank of matrix	
		(c) Row equivalent matrices	

	3	**Inverse of a matrix**	
		(a) Existence of inverse	
		(b) Inverse by Gauss-Jordan method	
II	**Functions and Limits**		**14**
	1	**Functions**	
		a) Trigonometric functions	
		b) Exponential functions	
		c) Inverse functions and logarithms	
	2	**Limits**	
		Limit of a function and limit laws	
III	**Continuity and Differentiation of functions**		**14**
	1	**Continuity**	
	2	**Differentiation**	
		a) Derivative – definition and meaning	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain rule	
		e) Implicit differentiation	
		f) Derivatives of inverse functions and logarithms	
		g) Derivatives of inverse trigonometric functions	
	3	**Successive differentiation**	
IV	**Probability**		**13**
	1	(a) Permutations, Combinations	
		(b) Basic terminology	
		(c) Probability and set notations	
		(d) Addition law of probability	
V	**Teacher Specific Module**		**5**

	Directions	
	Graphs of functions mentioned in Unit 1 in Module I	
	Precise definition of limit, One-sided limit (Sections 2.3, 2.4)	
	Any topic related to Module I, II, III & IV	

Essential Readings

1. E. Kreyszig, Advanced Enginering Mathematics (10^{th} edition), John Wiley & Sons

2. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12^{th} edition), Pearson Education

3. B.S. Grewal, Higher Engineering Mathematics (43^{rd} edition), Khanna Publishers.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Section 7.1, 7.2	*Relevant topics only. Multiplication by linear transformations and application of matrix multiplication are omitted*
	2	1	Section 7.4	*Relevant topics only. Proof of theorem 3, theorem 4 and vector space are omitted*
	3	1	Section 7.8	*Relevant topics only. Proof of theorem 1 is omitted*
II	1	2	Sections 1.3, 1.5, 1.6	*Quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3*
	2	2	Section 2.2	*Proofs of all theorems are omitted*
III	1	2	Section 2.5	

	2	2	Sections 3.1, .3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9	
	3	3	Section 4.2	
IV	1	3	Sections 26.1, 26.2, 26.3, 26.4	

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10th edition , Willey
2. S. Narayan and P.K Mittal , Differential calculus, Revised Edition, S. Chand & Company Ltd
3. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Willey

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT116

CALCULUS AND COORDINATE SYSTEMS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT116	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers the foundational concepts of functions, limits, differentiation, integration, and coordinate systems, providing students with the skills to analyze and solve mathematical problems involving trigonometric, exponential, logarithmic, and hyperbolic functions, limits and continuity, derivatives and integration techniques, and multiple coordinate systems.

Course Prerequisite

Functions and cartesian geometry

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand and apply trigonometric, exponential, inverse, and logarithmic functions in various mathematical contexts.	Understand
2	Gain proficiency in working with hyperbolic functions and their properties.	Understand
3	Master the concepts of limits, limit laws, and continuity, and apply them to solve problems involving the behaviour of functions.	Apply

4	Understand the concept of the derivative as a function, learn various differentiation rules, and apply them to compute derivatives of functions.	Understand
5	Comprehend the concept of the definite integral, view integration as the inverse process of differentiation, and apply various integration techniques	Understand
6	Demonstrate the applications of integration, and grasp the fundamental theorem of calculus.	Apply
7	Understand and convert between different coordinate systems, including Cartesian, polar, cylindrical, and spherical coordinates, and comprehend the relationships between these systems.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5			✓				
CO 6		✓					
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I	**Functions and Limits**		
	1	**Functions**	

		a) Trigonometric functions	14
		b) Exponential functions	
		c) Inverse functions and Logarithmic functions	
		d) Hyperbolic functions	
	2	**Limits and Continuity**	
		a) Limit of a function and limit laws	
		b) Continuity	
II	**Differentiation**		14
	1	**Derivatives**	
		a) The derivative as a function	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain rule	
		e) Derivatives of inverse functions and logarithms	
		f) Derivatives of inverse trigonometric functions	
III	**Integration**		**14**
	1	a) The Definite Integral	
		b) Fundamental theorem of calculus (without proof)	
		c) Integration as the inverse of differentiation	
		d) Integration by inspection	
		e) Integration of sinusoidal functions	
		f) Logarithmic integration	
		g) Applications of integration	
IV	**Coordinate system**		**13**
	1	a) Polar coordinates	
		b) Graphing in Polar Coordinates	
		c) Cylindrical coordinates	
		d) Spherical coordinates	
		e) Relation between coordinate system	

V	**Teacher specific module**		**5**
	Directions		
	1	Graphs of functions mentioned in Unit 1 in Module I	
		Precise definition of limit, one-sided limit	
		The logarithm is defined as an integral	
		Problems in exercises 7.3 **(**Hyperbolic functions)	
		Integration of rational functions by partial fractions	
		Applications of integral and differential calculus in Physics	

Essential Readings

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education
2. K F Riley, M B Hobson, S J Bence, Mathematical Methods for Physics and Engineering

Reference Distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 1.3,1.5,1.6	*Quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3*
		2	Section 3.7	
	2	1	Section 2.2 ,2.5	
II	1	1	Sections 3.2, 3.3, 3.5, 3.6, 3.8, 3.9	
III	1	1	Section 5.3, 5.4	
		2	Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.13	
IV	1	1	Section 11.3,11.4 and 15.7	*Excluding integration part*

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10th edition , Willey
2. Higher Engineering Mathematics, B.S. Grewal (43rd edition), Khanna Publishers
3. S Narayan and P.K Mittal , Differential calculus, Revised Edition, S. Chand & Company Ltd
4. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Willey

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT117: CALCULUS AND MATRIX ALGEBRA I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCMAT117	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces fundamental concepts in calculus covering functions, limits, continuity, differentiation and integration, alongside essential matrix algebra topics such as row echelon form, elementary row transformations, rank, and simultaneous equations.

Course Prerequisite

Familiarity with functions and foundational understanding of matrices.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend trigonometric functions, exponential functions, inverse functions, logarithmic function and hyperbolic functions	Understand
2	Apply Exponential growth and decay in Finance and in Radioactive decay	Apply
3	Understand the notion of limit and limit laws	Understand
4	Understand continuity of a function	Understand
5	Comprehend the notion of derivative of a function and differentiation rules	Understand
6	Comprehend the indefinite and definite integrals	Understand
7	Understand basic matrix operations	Understand

8	Understand Rank of a matrix, elementary raw and column operations	Understand
9	Solve systems of linear equations using row-echelon form	Understand
10	Solve linear systems using Gaussian elimination algorithm	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2						✓	
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						
CO8	✓						
CO9	✓						
CO10	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Functions and Limits**	13
	1	**Functions**	
		a) Trigonometric functions	
		b) Exponential functions	
		c) Inverse functions and Logarithms	
		d) Hyperbolic functions (Definitions and identities)	
	2	**Limits**	
		Limit of a function and Limit Laws	

II	**Continuity and Differentiation of functions**		**14**
	1	**Continuity**	
	2	**Differentiation**	
		a) The Derivative as a Function	
		b) Differentiation rules	
		c) Derivatives of trigonometric functions	
		d) The Chain Rule	
		e) Implicit differentiation	
		f) Derivatives of inverse functions and logarithms	
		g) Derivatives of inverse trigonometric functions	
		h) Derivatives of hyperbolic functions	
III	**Integration**		**14**
	1	**Indefinite integrals**	
		a) Integral of a function	
		b) The study of Integral Calculus	
		c) Indefinite Integral	
		d) Indefinite integrals and the substitution method	
		e) Integration by parts	
		f) Trigonometric substitutions	
		g) Integration of rational functions by partial fractions	
	2	Definite integrals	
		a) Definite integral	
		b) Geometric interpretation of definite integral (without proof)	
IV	**Matrices**		**14**
	1	**Basic Operations**	
		a) Matrix Addition, Subtractions, Scalar Multiplication, Matrix Multiplication and Transpose of a Matrix.	
		b) Row-Echelon form	
		c) Elementary Row and Column Operations	
		d) Rank of a Matrix	
	2	**Simultaneous Linear Equations**	

		a) Consistency, Matrix notation	
		b) Theory of solutions, Simplifying operations, Gaussian elimination algorithm, Pivoting strategies	
		c) Gauss-Jordan elimination.	
V	**Teacher Specific Module**		**5**
	Directions		
	Graphs of functions mentioned in Unit 1 in Module I		
	Precise definition of limit, One-sided limit		
	Elementary matrices , LU Decomposition, Solve simultaneous linear equations by LU Decomposition method		
	Any topic related to Module I, II, III & IV		

Essential Readings

1. Thomas, G. B., Weir, M. D., & Hass, J. R. (2010), *Thomas' Calculus: Early Transcendentals* (12th ed.), Pearson Education.
2. Narayan S. and Mittal P.K., Integral Calculus (Revised edition), S. Chand & Company Ltd.
3. Bronson, R. (2011), *Theory and Problems of Matrix Operations* (2nd ed.), Schaum's Outline Series, McGraw-Hill.

Reference Distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 1.3, 1.5, 1.6, 7.3	*Quick review of Section1.3 is needed. Questions should not be asked in the End Semester Examination from section 1.3*
	2	1	Section 2.2	*Proofs of all the theorems are excluded.*
II	1	1	Section 2.5	
	2	1	Sections 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9 ,7.3	
III	1	2	For 1(a), (b) & (c), Sections 1.1, 1.2, 1.3, 1.4 & 1.5	
		1	For 1(d), (e), (f) & (g), Sections 5.5,, 8.1, 8.3 & 8.4	

	2	2	Sections 1.6, 1.7, 1.8	
IV	1	3	Chapter 1	*Quick review of matrix addition, subtraction, scalar multiplication,matrix multiplication, and transpose of a matrix. Questions from these topics should not be asked in the End Semester Examination.*
	2	3	Chapter 2	*Proofs of all theorems are excluded.Pivoting strategies and Gauss-Jordan elimination are also excluded.*

Suggested Readings

1. Anton, H., Bivens, I., & Davis, S. (2012). *Calculus* (10th ed.). Wiley.
2. Grewal, B. S. (2015). *Higher Engineering Mathematics* (43rd ed.). Khanna Publishers
3. Narayan, S., & Mittal, P. K. (2014). *Differential Calculus* (Revised ed.). S. Chand & Company Ltd.
4. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley.
5. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020*). Linear Algebra and Its Applications* (6*th* ed.). Pearson Education.
6. Narayan, S. & Mittal, P. K. (2004*). Textbook of Matrices*. S. Chand & Company Ltd.
7. Ayres, F. Jr. (1966). *Theory and Problems of Matrices* (Schaum's Outline Series). McGraw-Hill.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

****Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT118: PROBABILITY THEORY - I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100	KU1DSCMAT118	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce Random variables, Distribution Functions, Mathematical Expectations, Joint Probability Law and Covariance

Course Pre-requisite

Set Theory, Integration

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend Random Variables	Understand
2	Understand Distribution Function	Understand
3	Understand Mathematical Expectations	Apply
4	Comprehend Joint Probability Law	Understand
5	Understand Covariance	Apply
6	Understand Jenson's Inequality	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓		✓				
CO 3	✓		✓	✓			
CO 4	✓		✓				
CO 5	✓		✓	✓		✓	
CO 6	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

<table>
<tr><th>MODULE</th><th>UNIT</th><th>DESCRIPTION</th><th>HOURS</th></tr>
<tr><td rowspan="4">I</td><td colspan="2">Random Variables and Distribution Functions</td><td rowspan="4">13</td></tr>
<tr><td rowspan="2">1</td><td>a) Random Variables</td></tr>
<tr><td>b) Distribution Functions</td></tr>
<tr><td>2</td><td>a) Discrete Random Variables and Examples</td></tr>
<tr><td rowspan="3">II</td><td colspan="2">Continuous Random Variables and Joint Probability Law</td><td rowspan="3">14</td></tr>
<tr><td>1</td><td>a) Continuous Random Variables and Examples</td></tr>
<tr><td>2</td><td>a) Joint Probability Law</td></tr>
<tr><td rowspan="6">III</td><td colspan="2">Transformation of Random variables, Mathematical Expectations</td><td rowspan="6">14</td></tr>
<tr><td rowspan="2">1</td><td>a) Transformation of one dimensional Random variables</td></tr>
<tr><td>b) Mathematical Expectation</td></tr>
<tr><td rowspan="3">2</td><td>a) Expectation of a function of Random Variables</td></tr>
<tr><td>b) Addition Theorem of Expectation</td></tr>
<tr><td>c) Multiplication Theorem of Expectation</td></tr>
<tr><td rowspan="4">IV</td><td colspan="2">Expectation, Covariance and Jenson's Inequality</td><td rowspan="4">14</td></tr>
<tr><td rowspan="2">1</td><td>a) Expectations of a linear combination of Random Variables</td></tr>
<tr><td>b) Covariance</td></tr>
<tr><td>2</td><td>a) Jenson's inequality</td></tr>
<tr><td rowspan="3">V</td><td colspan="2">Teacher Specific Module</td><td rowspan="3">5</td></tr>
<tr><td colspan="2">Directions</td></tr>
<tr><td colspan="2">R programming</td></tr>
</table>

Essential Readings

1. S C Gupta & V K Kapoor, Fundamentals of Mathematical Statistics (10th revised edition), S Chand & Sons, 2002
2. Peter Dalgard, Introductory Statistics with R, Springer, 2008.

Reference distribution

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 5.1, 5.2	Proof of all the Theorems in this unit are omitted
	2	1	Section 5.3	Proof of all the Theorems in this unit are omitted
II	1	1	Section 5.4	Proof of all the Theorems in this unit are omitted. Quartiles are omitted.
	2	1	Section 5.5	
III	1	1	Sections 5.6, 6.1	
	2	1	Sections 6.2, 6.3, 6.4	
IV	1	1	Sections 6.5, 6.6	Proof of all the Theorems in this unit are omitted
	2	1	Sections 6.7	Proof of all the Theorems in this unit are omitted
V	1	2	Relevant topics	

Suggested Readings

1. Dennis Wackerly, William Mendenhall Ill and Richard S, Mathematical Statistics with Application (Seventh Edition), Duxbury Press, 2007
2. Robert. V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics (Fifth Edition), Higher education press, 1978
3. G Shankar Rao, Probability and Statistics for Science and Engineering, University press, 2011
4. Maria Dolores Ugarte, Ana F.Militino, Alan T. Amholt; Probability and Statistics with R; CRC Press, A Chapman & Hall Book
5. Frank S Emmert-Streib, Salissou Moutari, Matthias Dehmer; Mathematical Foundations of Data Science Using R; De Gruyter, 2022.
6. Meatloaf, Norman S; Probability and Statistics for data Science-Math+R+Data; CRC Press(2020)

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU1DSCMAT119: FOUNDATIONS OF MATHEMATICS - 1

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU2DSCMAT119	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce the notion of Functions Different types of functions Relations, Partial Order relations, Well-ordering theorem, Countability and uncountability of sets.

Course Pre-requisite

Sets, Relations and Functions.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts of Relations	Understand
2	How to apply induction hypothesis in proof making	Apply
3	Understand the concept of well ordering principle	Understand
4	Understand the concept of cardinality of sets	Understand
5	Comparing the cardinality of two sets	Apply
6	Understand the concept of partially ordered sets	Understand
7	Application of axiom of choice	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓	✓				
CO 2	✓	✓	✓			✓	
CO 3	✓	✓	✓				
CO 4	✓	✓	✓				
CO 5	✓	✓	✓			✓	
CO 6	✓	✓	✓				
CO 7	✓	✓	✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Relations**	13
	1	Relations on sets	
	2	Types of relations	
	3	Equivalence relations	
	4	Equivalence classes and partitions of a set	
II		**Induction Principles**	14
	1	The Induction Principle	
	2	The Strong Induction Principle	
	3	The Well-ordering Principle	
	4	Equivalence of the three principles	
III		**Countability of Sets**	14
	1	Sets with same cardinality	
	2	Finite sets	

	3	Countable sets	
	4	Comparing cardinality	
IV	**Order Relations**		**14**
	1	Partial and Total Orders	
	2	Chains, bounds and maximal elements	
	3	Axiom of Choice and its Equivalents	
V	**Teacher Specific Module**		**5**
	Directions		
	Functions, One-one, onto functions and bijections, Composition of functions, Inverse of a function, Image of subsets under functions, Inverse image of subsets under functions		

Essential Readings

1. Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, A Foundation Course in Mathematics, 9th Edition, Alpha Science International Ltd., Oxford, U.K., 2018.

Reference distribution

Module	**Unit**	**Essential Reading No.**	**Sections**	**Remarks**
I	1 to 4	1	*Sections 4.1 to 4.4*	
II	1 to 4	1	*Sections 5.1 to 5.4*	
III	1 to 4	1	*Sections 6.1 to 6.4*	
IV	1 to 3	1	*Sections 7.1 to 7.3*	
V		1	*Sections 3.1 to 3.4*	

Suggested Readings

1. Kenneth Kunen; The Foundation of Mathematics; College Publications 2009
2. John Peterson; Building a Foundation in Mathematics; Delmar Cengage Learning, 2011.
3. K A Stroud; Foundation Mathematics; Bloomsbery; 2009
4. S Lipschutz; Set Theory & Related Topic; 2nd Edition; Schoum's Outline Series.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar, Viva-Voce	12
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU2DSCMAT101: CALCULUS II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT101	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course discusses applications of derivatives, reduction formulae for integration, functions of several variables and partial derivatives.

Course Prerequisite

Limit, continuity, derivative and integral of function of a single variable.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend successive differentiation	Understand
2	Employ the notion of derivatives to determine extreme values of functions	Apply
3	Understand mean value theorems	Understand
4	Find expansions of functions employing Maclaurin’s series and Taylor’s series	Understand
5	Identify indeterminate forms and employ L ’ H opital’s rule to compute limits of indeterminate forms	Understand
6	Solve optimization problems in Mathematics and Economics using derivatives	Apply
7	Employ integration by successive reduction	Understand
8	Comprehend functions of several variables and their domain and range	Understand

9	Understand the notions of limits and continiuty of functions of two variables and limit laws	Understand
10	Find partial derivatives and employ chain rule for functions of two and three independent variables	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓		✓	✓			
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6				✓			
CO 7	✓						
CO 8	✓						
CO 9	✓						
CO 10	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Applications of differentiation I**		14
	1	**Successive differentiation**	
	2	**Applications of derivatives**	
		(a) Extreme values of functions	
		(b) The mean value theorem – Rolle's theorem, Lagrange's mean value theorem	
		(c) Maclaurin's series, Taylor's series and expansions of functions	
II	**Applications of differentiation II**		
	1	**Monotonic functions and the first derivatives test**	

	2	**Indeterminate forms and L ' H opital's rule**	**14**
	3	**Applied optimization** Application of derivatives to solve optimization problems	
III		**Integration – Reduction formulae**	**13**
	1	**Reduction formulae**	
	2	**Integration of trigonometric functions**	
		(a) Integration of $sin^n x$, evaluation of the definite integral $\int_0^{\frac{\pi}{2}} sin^n x\, dx$	
		(b) Integration of $cos^n x$, evaluation of the definite integral $\int_0^{\frac{\pi}{2}} cos^n x\, dx$	
		(c) Integration of $sin^p x cos^q x$, evaluation of the definite integral $\int_0^{\frac{\pi}{2}} sin^p x\, cos^q x dx$	
		(d) Integration of $tan^n x$	
IV		**Partial derivatives**	**14**
	1	**Functions of several variables**	
	2	**Limits and continuity**	
		(a) Limit of a function of two variables	
		(b) Continuity of a function of two variables	
	3	**Partial derivatives**	
		(a) Partial derivatives of functions of two and three variables	
		(b) Second order partial derivatives	
		(c) Mixed derivatives theorem	
		(d) Partial derivatives of higher order	
	4	**Chain rule for functions of two and three independent variables**	
V		**Teacher Specific Module**	**5**
		Directions	
		Concavity	
		Integration of $cot^n x$, $sec^n x$, $cosec^n x$	
		Differentiability of function of two variables	
		Any topic related to Module I, II, III & IV	

Essential Readings

1. Higher Engineering Mathematics, B.S. Grewal (44^{th} edition), Khanna Publishers
2. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus:Early Transcendentals (12^{th} edition), Pearson Education
3. S. Narayan and P.K. Mittal , Integral calculus, Revised Edition, S. Chand & Company Ltd.

Reference Distribution

Module	Unit	Reference No.	Sections/Page Nos.	Remarks
I	1	1	Section 4.1	
	2	2	For 2(a) & (b), Sections 4.1 & 4.2	
		1	For 2(c), Section 4.4	
II	1	2	Section 4.3	
	2	2	Section 4.5	
	3	2	Sections 4.6	*Examples 4 & 5 are omitted*
III	1	3	Section 2.8	
	2	3	Sections 4.1, 4.1.1, 4.2, 4.2.1, 4.3, 4.3.1, 4.4.1	
IV	1	2	Section 14.1	*Example 3, interior point & boundary point are omitted*
	2	2	Section 14.2 (Pages 773-778)	*Examples 3 and other related problems in exercise which require ε-δ definition of limit are omitted*
	3	2	Section 14.3	*Differentiability (page 789) is omitted*
	4	2	Section 14.4	

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10^{th} edition , Willey
2. S. Narayan and P.K Mittal , Differential calculus, Revised Edition, S. Chand & Company Ltd

3. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Willey

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT111
BASIC MATHEMATICS II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCMAT111	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers fundamental concepts in mathematics for computer applications, including basics on vectors, basics on probability, reduction formulae for sine, cosine and tangent functions, Fourier series basics and half-range expansions.

Course Prerequisite

Basic awareness of vectors, derivatives and integrals

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand three-dimensional coordinate systems, properties of vectors and lines and planes in space	Understand
2	Understand the meaning of probability, probability and set notations, random experiment, sample space, event, axioms, notations, addition law of probability, theorem of total probability, Independent events and multiplication law of probability.	Understand
3	Use integration techniques to trigonometric functions	Understand

4	Comprehend Fourier series	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I	**Vectors and the Geometry of Space**		14
	1	Three-Dimensional Coordinate Systems	
	2	Vectors	
	3	The Dot Product	
	4	The Cross Product	
	5	Lines and Planes in Space (a) Vector and parametric equations for Lines and line segments in space (b) Vector and parametric equations for a plane in space	
II	**Probability**		14
	1	Introduction	
	2	Basic Terminology	
	3	Probability and Set Notations	
	4	Addition Law of Probability or Theorem of Total Probability	
	5	Independent Events	

III	**Integration of Trigonometric functions**		13
	1	Integration of $sin^n x$	
	2	Integration of $cos^n x$	
	3	Integration of $sin^p x\ cos^q x$	
IV	**Fourier Series**		14
	1	Fourier Series, A Basic Example	
	2	Arbitrary Period. Even and Odd Functions.	
V	**Teacher Specific Module**		**5**
	Directions		
	Applications of vectors (Module 1), Half-Range expansions (Module IV)		
	Any topic related to Module I, II, III & IV		

Essential Readings

1. Thomas'Calculus (12th edition), Maurice D. Weir and Joel Hass, Pearson India Education Services.
2. Higher Engineering Mathematics (41st edition), B.S. Grewal, Khanna Publications
3. Integral Calculus, Santhi Narayanan and P.K. Mittal, S. Chand and Co.
4. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley

Reference Distribution

Module	Unit	Reference No.	Section	Remarks
I	1	1	12.1	
	2	1	12.2	
	3	1	12.3	
	4	1	12.4	
	5	1	12.5	*Topics related to distance, lines of intersection and angle between planes are excluded*
II	1	2	26.1	
	2	2	26.2	

	3	2	26.3	
	4	2	26.4	*Proofs are excluded*
	5	2	26.5	*Proofs are excluded*
III	1	3	4.1	*4.1.1 is excluded*
	2	3	4.2	*4.2.1 is excluded*
	3	3	4.3	*4.3.1 is excluded*
IV	1	4	11.1	*Excluded derivation of the Euler formulae and convergence and sum of a Fourier series*
	2	4	11.2	*Half-Range expansion is excluded*

Suggested Readings

1. Naive Set Theory, Paul R. Halmos, Dover Publications Inc. Mineola
2. Elementary number theory, David Burton, Mc Graw Hill
3. Differential and Integral Calculus, S. Narayanan and T.K.M. Pillay, S. Viswanathan Printers and Publishers, Chennai
4. A Textbook of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Pub.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT112
DIFFERENTIAL CALCULUS, CURVE FITTING AND COORDINATE SYSTEMS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT112	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course discusses functions of several variables, partial derivatives, successive differentiation, application of derivatives to determine maxima/minima of functions, gradient of a scalar field, divergence and curl of vector fields, principle of least squares for fitting of curves and coordinate systems – Cartesian, polar, cylindrical and spherical coordinates.

Course Prerequisite

Limit, continuity, derivative of a function of a single variable, 2-dimensional geometry, vectors.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend functions of several variables and their domain and range	Understand
2	Understand the notion of limit of a function of two variables and limit laws	Understand
3	Understand continuity of a function of two variables	Understand
4	Find partial derivatives	Understand

5	Employ chain rule for functions of two and three independent variables	Understand
6	Comprehend successive differentiation	Understand
7	Employ the notion of derivatives to determine extreme values of functions	Apply
8	Understand gradient, directional derivative, divergence and curl	Understand
9	Apply the principle of least squares for fitting of curves	Apply
10	Understand Cartesian, polar, cylindrical and spherical coordinate systems and relationships between them	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓		✓	✓			
CO 8	✓						
CO 9	✓			✓		✓	
CO 10	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Partial derivatives**	14
	1	**Functions of several variables**	
	2	**Limits and continuity of functions of two variables**	
	3	**Partial derivatives**	
		(a) Partial derivatives of functions of two and three variables	
		(b) Second order partial derivatives	
		(c) Mixed derivatives theorem	
		(d) Partial derivatives of higher order	
	4	**Chain rule for functions of two and three independent variables**	
II		**Applications of differentiation**	14
	1	**Successive differentiation**	
	2	**Maxima and minima of functions**	
	3	**Vector calculus**	
		(a) Scalar and vector point functions, vector operator *del*	
		(b) Gradient, directional derivative	
		(c) Divergence, Curl	
III		**Curve fitting**	14
	1	(a) Introduction, scatter diagram, curve fitting	
		(b) Graphical method	
		(c) Laws reducible to the linear law	
		(d) Principle of least squares	
		(e) Method of least squares - to fit the straight line $y = a + bx$, to fit the parabola $y = a + bx + cx^2$	
IV		**Coordinate systems**	13
	1	**Three-Dimensional Coordinate sustems**	

	2	**Polar coordinates**	
	3	**Cylindrical and Spherical coordinates**	
V	**Teacher Specific Module**		**5**
	Directions		
	Any topic related to Module I, II, III & IV		

Essential Readings

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus:Early Transcendentals (12^{th} edition), Pearson Education
2. Higher Engineering Mathematics, B.S. Grewal (42^{nd} edition), Khanna Publishers

Reference Distribution

Module	Unit	Reference No.	Sections/Page Nos.	Remarks
I	1	1	Section 14.1	
	2	1	Section 14.2	*Definitions only*
	3	1	Section 14.3	*Differentiability (page 789) is omitted*
	4	1	Section 14.4	*Proof of theorem 5 & topics after Example 2 are excluded*
II	1	2	Section 4.1	
	2	2	Section 4.15 (1), (2), (3)	*Excluded 4.15(4)*
	3	2	Sections 8.4, 8.5, 8.6	
III	1	2	Sections 24.1, 24.2, 24.3, 24.4, 24.5	
IV	1	1	Section 12.1	
	2	1	Section 11.3	
	3	1	Section 15.7	*Only relevant portions from Section 15.7*

Suggested Readings

1. H. Anton, I. Bivens and S. Davis, Calculus, 10^{th} edition , Willey

2. S. Narayan and P.K Mittal , Differential calculus, Revised Edition, S. Chand & Company Ltd
3. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Willey

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT113
SET THEORY, NUMBER THEORY, INTEGRAL CALCULUS AND FOURIER SERIES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100	KU2DSCMAT113	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers fundamental concepts in mathematics for computer science, including set theory with operations, properties of integers including gcd and lcm, integration of trigonometric functions, Fourier series basics, and half-range expansions, preparing students for advanced computational analysis.

Course Prerequisite

Basics ideas in integration.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand sets and subsets, operations on sets, and properties of integers.	Understand
2	Comprehend properties of integers, including the notions of greatest common divisor and least common multiple.	Understand
3	Apply integration techniques to trigonometric functions and Fourier series.	Understand
4	Comprehend Fourier series	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3			✓				
CO 4	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Set theory**	13
	1	Sets and Subsets	
	2	Operations on Sets	
II		**Properties of Integers**	14
		a) Properties of Integers	
		b) Greatest Common Divisor	
		c) Least Common Multiple	
		d) Representations of Integers	
III		**Integration of Trigonometric functions**	14
	1	Integration of $sin^n x$	
	2	Integration of $cos^n x$	
	3	Integration of $sin^p x\ cos^q x$	
IV		**Fourier Series**	14
	1	Fourier Series, A Basic Example	
	2	Arbitrary Period, Even and Odd Functions	

V	**Teacher Specific Module**	5
	Directions	
	Sequences, Characteristic Functions, Computer Representation of Sets and Subsets (Module 1, Section 1.3)	
	Pseudo code Versions for finding GCD (Module 2, Section 1.4)	
	Half-Range Expansions (Fourier series)	
	Any topic related to Module I, II, III & IV	

Essential Readings

1. Discrete Mathematical Structures (Sixth edition), Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, Pearson
2. Calculus, Santhi Narayanan and P.K. Mittal, S. Chand and Co.
3. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	1.1	
	2	1	1.2	
II	1	1	1.4	*Exclude Pseudo code Versions and Proofs of theorems 4,6 & 7.*
III	1	2	4.1	*4.1.1 is excluded*
	2	2	4.2	*4.2.1 is excluded*
	3	2	4.3	*4.3.1 is excluded*
IV	1	3	11.1	*Exclude derivation of the Euler formulae and convergence and sum of a Fourier series. Also exclude Half-Range expansions*
	2	3	11.2	

Suggested Readings

1. Naive Set Theory, Paul R. Halmos, Dover Publications Inc. Mineola
2. Elementary number theory, David Burton, Mc Graw Hill
3. Differential and Integral Calculus, S. Narayanan and T.K.M. Pillay, S. Viswanathan Printers and Publishers, Chennai

4. A Textbook of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Pub.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT114: MATHEMATICAL ECONOMICS II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT114	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces fundamental concepts in mathematical economics, including integration, economic applications of integration, definite integrals and their properties, and the fundamentals of matrix algebra.

Course Prerequisite

Proficiency in basic algebraic operations and basic understanding of functions.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concept of integration and properties	Understand
2	Understand the geometric interpretation of the definite integral	Understand
3	Apply the Fundamental Theorem of Calculus to evaluate definite integrals	Understand
4	Compute consumers' and producers' surplus using the concept of definite integrals..	Apply
5	Apply integration techniques to solve problems in economics, such as calculating total cost, total revenue, and consumer and producer surplus.	Apply
6	Understand the fundamentals of Matrix algebra	Understand
7	Understand the concepts of cofactor and adjoint matrices	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4						✓	
CO 5						✓	
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Integral calculus**	14
	1	Indefinite Integral	
		a) Integration	
		b) Rules of Integration	
		c) Initial conditions and Boundary conditions	
		d) Economic Application	
II		**The Definite Integral**	13
	1	a) Area under a curve, The definite integral	
		b) The fundamental theorem of calculus	
		c) Properties of definite integral	
		d) Consumers and Producers Surplus	
III		**Fundamentals of Matrix Algebra - I**	14
	1	a) Definitions and Terms	
		b) Addition and Subtraction of Matrices	

		c) Scalar Multiplication	
		d) Vector Multiplication	
		e) Multiplication of Matrices	
		f) Identity and Null Matrices	
IV	**Fundamentals of Matrix Algebra - II**		14
	1	a) Determinants and Non-singularity	
		b) Third order Determinates	
		c) Minors and Cofactors	
		d) Cofactor and Adjoint matrices	
		e) Inverse Matrices	
V	**Teacher Specific Module**		5
	Directions		
	Area between curves		
	The Role of Linear Algebra, Commutative, associative and distributive laws in Matrix Algebra, Properties of determinants.		

Essential Readings

1. Edward T. Dowling, Introduction to Mathematical Economics, Third Edition, Schaum's Outline Series, McGraw-Hill International Edition.

Reference Distribution

Module	Unit	Reference No.	Section	Remarks
I	1	1	Sections 14.1, 14.2, 14.3, 14.6	
II	1	1	Sections 15.1,15.2,15.3,15.4,15.8	
III	1	1	Sections 10.2, 10.3, 10.4, 10.5, 10.6, 10.8	
IV	1	1	Sections 11.1, 11.2, 11.3, 11.6, 11.7	

Suggested Readings

1. Barauh, Srinath. (2010). *Basic Mathematics and Its Application in Economics*. Amanad, New Delhi.
2. Hammond, Peter J., & Sydsaeter, Knut. (2010). *Mathematics for Economic Analysis*. Pearson.
3. Allen, R.G.D. (1956). *Mathematical Analysis for Economists*. Macmillan.
4. Yamane, Taro. (2004). *Mathematics for Economists: An Elementary Survey*. PHI, New Delhi.
5. Chiang, A.C. (1988). *Fundamental Methods of Mathematical Economics*. McGraw Hill.
6. Chiang, A.C., & Wainwright, K. (2013). *Fundamental Methods of Mathematical Economics* (Fourth edition). Tata McGraw-Hill Education.
7. Allen, R.G.D. (1976). *Mathematical Economics* (2nd ed.). Macmillan.
8. Baumol, W.J. (1987). *Economic Theory and Operations Analysis* (4th ed.). Prentice Hall of India.
9. Mas-Colell, A., Whinston, M.D., & Green, J.R. (1995). *Microeconomic Theory*. Harvard University Press.
10. Hands, D.W. (1991). *Introductory Mathematical Economics*. D.C. Heath.
11. Handy, S.T. (1997). *Operations Research*. Prentice-Hall of India, New Delhi.
12. Mukherji, B., & Pandit, V. (1982). *Mathematical Method of Economic Analysis*. Allied Publishers, New Delhi.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT115
LINEAR ALGEBRA, DIFFERENTIAL CALCULUS AND VECTORS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT115	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course discusses applications of matrices and determinants to solve system of linear equations, eigenvalues and eigenvectors, functions of several variables, partial derivatives, indefinite and definite integrals and basic ideas in vectors.

Course Prerequisite

Basic operations of matrices, Limit, continuity, derivative and integral of function of a single variable.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Apply matrices and determinants to solve system of linear equations	Understand
2	Compute eigenvalues and eigenvectors	Understand
3	Comprehend functions of several variables and their domain and range	Understand
4	Understand the notion of limit of a function of two variables and limit laws	Understand
5	Find partial derivatives	Understand

6	Comprehend indefinite integrals and definite integrals	Understand
7	Understand vectors and scalar product, cross product and box product of vectors	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Linear Algebra**	14
	1	**Solution of system of linear equations**	
		(a) Consistency	
		(b) Matrix notation	
		(c) Cramer's rule	
	2	**Eigenvalues and eigenvectors**	
II		**Partial derivatives**	
	1	Functions of several variables	

	2	**Limits**	**14**
		limit of a function of two variables	
	3	**Partial derivatives**	
		(a) Partial derivatives of functions of two and three variables	
		(b) Second order partial derivatives	
		(c) Mixed derivatives theorem	
		(d) Partial derivatives of higher order	
III	**Integration**		**14**
	1	**Indefinite integrals**	
		a) Integral of a function	
		b) The study of Integral Calculus	
		c) Indefinite integral	
		d) Indefinite integrals and the substitution method	
	2	**Definite integrals**	
IV	**Vectors**		**13**
		(a) Three dimensional coordinate system	
		(b) Vectors	
		(c) The dot product	
		(d) The cross product, Triple scalar or Box product	
V	**Teacher specific module**		**5**
	Directions		
	Integration by parts		
	Trigonometric substitutions		
	Integration of rational functions by partial fractions		

Essential Readings

1. Bronson, R. (2011). Theory and Problems of Matrix Operations (2nd edition), Schaum's Outline Series, McGraw-Hill.
2. Kreyszig, E. (2011). Advanced Engineering Mathematics (10th ed.). Wiley.
3. Thomas Jr., G. B., Weir, M. D., & Hass, J. R. (2014). Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education.

4. Narayan S. and Mittal P.K., Integral calculus (Revised Edition), S. Chand & Company Ltd.

Reference Distribution

Module	Unit	Reference No.	Sections/Page Nos.	Remarks
I	1(a), (b)	1	Chapter 2	*Consistency and matrix notation only*
	1(c)	2	Section 3.8	*Problems using Cramer's rule only*
	2	2	Section 8.1	*Problems for finding eigenvectors of 3x3 matrices is omitted*
II	1	3	Section 14.1	
	2	3	Section 14.2	*Definition of limit only*
	3	3	Section 14.3	*Differentiability (page 789) is omitted*
III	1	4	For 1(a), (b) & (c), Sections 1.1, 1.2, 1.3, 1.4 & 1.5	
		3	For 1(d), Section 5.5	
	2	4	Sections 1.6, 1.7	
IV	1	3	Sections 12.1, 12.2, 12.3, 12.4	*Quick review of Section 12.1 is needed. Questions shall not be asked for the end semester examination from section 12.1*

Suggested Readings

1. Anton, H., Bivens, I. & Davis, S. (2012). Calculus (10^{th} ed.). Wiley.
2. Narayan, S., & Mittal, P. K. (Revised Edition). Differential Calculus. S. Chand & Company Ltd.
3. Narayan, S., & Mittal, P. K., A Text book of Matrices, S. Chand & Company Ltd.
4. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). Linear Algebra and Its Applications (6^{th} ed.). Pearson Education.

5. Ayres, F. Jr. (1966). Theory and Problems of Matrices (Schaum's Outline Series). McGraw-Hill.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.

KU2DSCMAT116: MULTIVARIABLE CALCULUS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT116	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers advanced calculus topics, including functions of several variables, limits and continuity in higher dimensions, partial derivatives, the chain rule, vector and scalar fields, vector calculus, gradients, divergence and curl, multiple integrals and line and surface integrals with applications.

Course Prerequisites

Differential and Integral Calculus

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand functions of several variables, including their limits and continuity in higher dimensions	Understand
2	Master the concepts of partial derivatives and the chain rule, and apply them to solve problems involving multivariable functions.	Apply
3	Understand the concepts of vector and scalar functions, and find the derivatives of these functions.	Understand
4	Gain proficiency in calculating the gradient of a scalar field, and the divergence and curl of a vector field, and understand their physical interpretations and applications.	Understand
5	Comprehend and compute double and triple integrals.	Understand
6	Understand and compute line integrals and surface integrals, explore path independence and conservative fields, and apply these concepts to physical and geometric problems.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓					✓	
CO 5	✓						
CO 6	✓					✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Partial Derivatives**		13
	1	a) Functions of Several Variables	
		b) Limits and Continuity in Higher Dimensions (*Definitions only*)	
		c) Partial Derivatives	
		d) The Chain Rule	
II	**Applications of Differentiation**		14
	1	a) Vector and Scalar Functions and Their Fields. Vector Calculus: Derivatives	
		b) Gradient of a Scalar Field. Directional Derivative	
		c) Divergence of a Vector Field	
		d) Curl of a Vector Field	
III	**Multiple Integrals**		14
	1	a) Double and Iterated Integrals over Rectangles	
		b) Double Integrals over General Regions	

		c) Triple Integrals in Rectangular Coordinates	
IV	**Integration in Vector Fields**		14
	1	a) Line Integrals	
		b) Path Independence, Conservative Fields and Potential Functions	
		c) Surfaces and Area	
		d) Surface Integrals	
V	**Teacher Specific Module**		**5**
	Directions		
		Moments and Centers of Mass	
		Area by Double Integration . Double Integrals in Polar Form. Triple Integrals in Cylindrical and Spherical Coordinates	
		Substitutions in Multiple Integrals	
		Vector Fields and Line Integrals: Work, Circulation, and Flux	
		Green's Theorem in the Plane	
		Any topic related to Module I, II, III & IV	

Essential Readings

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education
2. Erwin Kreyszig, Advanced Engineering Mathematics (10th edition)

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 14.1,14.2,14.3,14.4	
II	1	2	Sections 9.4, 9.7, 9.8, 9.9	
III	1	1	Section 15.1, 15.2, 15.5	
IV	1	1	Section 16.1, 16.3, 16.5, 16..6	

Suggested Readings

1. H. F. Davis and A. D. Snider, Introduction to Vector Analysis (6th edition), Universal Book Stall, New Delhi.

2. F. W. Bedford and T. D. Dwivedi, Vector Calculus, McGraw Hill Book Company
3. H. Anton, I. Bivens and S. Davis, Calculus (10^{th} edition), Willey
4. Higher Engineering Mathematics, B.S. Grewal (43^{rd} edition), Khanna Publishers.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of the best two tests is to be considered for the internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT117
CALCULUS AND MATRIX ALGEBRA-II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT117	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course discusses applications of derivatives, functions of several variables, partial derivativs, reduction formulae for integration, , matrix inversion using elementary raw operation, eigenvalues and eigenvectors and the Cayley-Hamilton theorem.

Course Prerequisite

Limit, continuity, derivative and integral of function of a single variable, basic operations of matrices.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend successive differentiation	Understand
2	Understand mean value theorems	Understand
3	Find expansions of functions employing Maclaurin's series and Taylor's series	Understand
4	Employ integration by successive reduction	Understand
5	Comprehend functions of several variables and their domain and range	Understand
6	Understand the notion of limit of a function of two variables and limit laws	Understand
7	Understand continuity of a function of two variables	Understand
8	Find partial derivatives	Understand

9	Employ chain rule for functions of two and three independent variables	Understand
10	Apply matrix inversion techniques to solve systems of linear equations efficiently	Understand
11	Comprehend Cayley-Hamilton Theorem	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						
CO 8	✓						
CO 9	✓						
CO 10	✓						
CO 11	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Applications of differentiation**	14
	1	Successive differentiation	
	2	**Applications of derivatives**	
		(a) Fundamental theorems: Role's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's theorem (Generalised mean value theorem)	
		(b) expansions of functions: Maclaurin's series, expansion by use of known series, Taylor's series	

II	**Partial derivatives**		14
	1	Functions of several variables	
	2	**Limits and continuity**	
		(a) limit of a function of two variables (*Definition only*)	
		(b) Continuity of a function of two variables (*Definition only*)	
	3	**Partial derivatives**	
		(a) Partial derivatives of functions of two and three variables	
		(b) Second order partial derivatives	
		(c) Mixed derivatives theorem	
		(d) Partial derivatives of higher order	
	4	Chain rule for functions of two and three independent variables	
III	**Integration – reduction formulae**		13
	1	Reduction formulae	
	2	**Integration of trigonometric functions**	
		(a) Integration of $sin^n x$, evaluation of the definite integral $\int_0^{\pi/2} sin^n\ x\, dx$	
		(b) Integration of $cos^n x$, evaluation of the definite integral $\int_0^{\pi/2} cos^n\ x\, dx$	
		(c) Integration of $sin^p x cos^q x$, evaluation of the definite integral $\int_0^{\frac{\pi}{2}} sin^p x\ cos^q x dx$	
		(d) Integration of $tan^n x$	
IV	**Matrices**		14
	1	**Matrix inversion**	
		(a) The Inverse	
		(b) Simple inverses	
		(c) Calculating inverses (Using elementary raw operations)	
		(d) Simultaneous linear equations	
		(e) Properties of the inverse	
	2	**Eigenvalues and Eigenvectors**	
		(a) Characteristic equation, characteristic polynomial, eigenvalues, eigenvectors	
		(b) Properties of eigenvalue and eigenvectors	
		(c) Cayley-Hamilton theorem	

<table>
<tr><td rowspan="6">V</td><td>Teacher specific module</td><td rowspan="6">5</td></tr>
<tr><td>Directions</td></tr>
<tr><td>Extreme values of functions</td></tr>
<tr><td>Applied optimization
Application of derivatives to solve optimization problems in mathematics and economics</td></tr>
<tr><td>Vectors, linearly independent vectors, raw rank, column rank , Cramer’s rule</td></tr>
<tr><td>Any topic related to Module I, II, III & IV</td></tr>
</table>

Essential Readings

1. Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.
2. Narayan, S., & Mittal, P. K. (Revised Edition). Integral Calculus. S. Chand & Company Ltd.
3. Thomas Jr., G. B., Weir, M. D., & Hass, J. R. (2014). Thomas' Calculus: Early Transcendentals (12th ed.). Pearson Education.
4. Bronson, R. (2011). Theory and Problems of Matrix Operations (2nd ed.). Schaum's Outline Series, McGraw-Hill.

Reference Distribution

<table>
<tr><th>Module</th><th>Unit</th><th>Reference No.</th><th>Sections/Page Nos.</th><th>Remarks</th></tr>
<tr><td rowspan="2">I</td><td>1</td><td rowspan="2">1</td><td>Section 4.1</td><td></td></tr>
<tr><td>2</td><td>Sections 4.3, 4.4</td><td>Proofs of all theorems are excluded</td></tr>
<tr><td rowspan="4">II</td><td>1</td><td>3</td><td>Section 14.1</td><td></td></tr>
<tr><td>2</td><td>3</td><td>Section 14.2</td><td></td></tr>
<tr><td>3</td><td>3</td><td>Section 14.3</td><td>Differentiability (page 789) is omitted</td></tr>
<tr><td>4</td><td>3</td><td>Section 14.4</td><td></td></tr>
<tr><td rowspan="2">III</td><td>1</td><td>2</td><td>Section 2.8</td><td></td></tr>
<tr><td>2</td><td>2</td><td>Sections 4.1, 4.1.1, 4.2, 4.2.1, 4.3, 4.3.1, 4.4.1</td><td></td></tr>
</table>

IV	1	4	Chapter 4	*4.13 and 4.14 are excluded*
	2	4	Chapter 7	*All problems related to linearly independent vectors, left and right eigenvalues, the proof of the Cayley-Hamilton theorem, and the proof of properties of eigenvalues and eigenvectors are excluded.* *Also, discuss only eigen vectors of* 2x2 *matrices only*

Suggested Readings

1. Anton, H., Bivens, I. & Davis, S. (2012). Calculus (10th ed.). Wiley.
2. Narayan, S., & Mittal, P. K. (Revised Edition). Differential Calculus. S. Chand & Company Ltd.
3. Kreyszig, E. (2011). Advanced Engineering Mathematics (10th ed.). Wiley.
4. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). Linear Algebra and Its Applications (6th ed.). Pearson Education.
5. Narayan, S., & Mittal, P. K. (2004). Textbook of Matrices. S. Chand & Company Ltd.
6. Ayres, F. Jr. (1966). Theory and Problems of Matrices (Schaum's Outline Series). McGraw-Hill.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.

KU2DSCMAT118: PROBABILITY THEORY II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT118	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce and understand Moment generating functions, Cumulants, Chebychev's Inequality, Bernoulli's distribution, Binomial distribution,Poisson distribution, Geometric distribution, Rectangular distribution, Normal distribution, Central limit Theorem.

Course Prerequisite

Contents of KU1DSCMAT118 Probability Theory I.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Moment generating functions, Cumulants	Understand
2	Understand Bernoulli's distribution	Understand
3	Understand Binomial distribution	Understand
4	Understand Poisson distribution	Understand
5	Understand Geometric distribution	Understand
6	Understand Rectangular distribution, Normal distribution	Understand
7	Understand and apply Central limit Theorem	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2	✓	✓	✓	✓		✓	
CO 3	✓	✓	✓	✓		✓	
CO 4	✓	✓	✓	✓		✓	
CO 5	✓	✓	✓	✓		✓	
CO 6	✓	✓	✓	✓		✓	
CO 7	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Moment generating functions, Cumulants, Chebychev's Inequality**		14
	1	a)Moment generating functions	
		b) Cumulants	
	2	a) Chebychev's Inequality	
II	**Bernoulli's distribution and Binomial distribution**		14
	1	Bernoulli's distribution	
	2	Binomial distribution	
III	**Poisson distribution, Geometric distribution**		13
	1	Poisson distribution	
	2	Geometric distribution	
IV	**Rectangular distribution, Normal distribution and Central limit Theorem**		14
	1	a) Rectangular distribution	

		b) Normal distribution	
	2	Central limit Theorem	
V	**Teacher Specific Module**		**5**
	Directions		
	R programming		

Essential Readings

1. S C Gupta & V K Kapoor; Fundamentals of Mathematical Statistics (10th revised edition), S Chand & Sons, 2002
2. Peter Dalgard -Introductory Statistics with R, Springer, 2008.

Reference distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 6.10, 6.11	Sections 6.10.1 ,6.11.2 are omitted
	2	1	Section 6.13	
II	1	1	Section 7.1	
	2	1	Sections 7.2, 7.2.1, 7.2.2 ,7.2.6, 7.2.7 ,7.2.9	
III	1	1	Section 7.3	Sections 7.3.1, 7.3.3, 7.3.6, 7.3.9, 7.3.10 are omitted
	2	1	Sections 7.5	7.5.1 ,7.5.2 are omitted
IV	1	1	section 8.1, 8.2	Section 8.1, 8.2, 8.2.1(derivation omitted) 8.2.14(fitting omitted) Sections 8.2.9, 8.2.10, 8.2.12, 8.2.15 are omitted
	2	1	Sections 8.10	Proof of C.L.T omitted. 8.10.1, 8.10.2, 8.10.3, 8.10.4 are omitted
V	1	2	Relevant topics	

Suggested Readings

1. Dennis Wackerly, William Mendenhall Ill and Richard S, Mathematical Statistics with Application (Seventh Edition), Duxbury Press, 2007
2. Robert. V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics (Fifth Edition), Higher education press, 1978
3. G Shankar Rao, Probability and Statistics for Science and Engineering, University press, 2011
4. Maria Dolores Ugarte, Ana F.Militino, Alan T. Amholt; Probability and Statistics with R, CRC Press, A Chapman & Hall Book
5. Frank S Emmert-Streib, Salissou Moutari, Matthias Dehmer; Mathematical Foundations of Data Science Using R, De Gruyter, 2022
6. Meatloaf, Norman S; Probability and Statistics for data Science-Math+R+Data, CRC Press, 2020.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2DSCMAT119: FOUNDATIONS OF MATHEMATICS-II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCMAT119	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce basic concepts of sets and relations and how they are used in computer language.

Course Prerequisite

Basic Set Theory

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concept of Sets and Relation	Understand
2	Comparing growth rates and functions	Apply
3	Understand the concept of Functions.	Understand
4	Understand the concept of Pigeon hole Principle.	Understand
5	Apply Recurrence relation for solving various problems.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓		✓		✓	
CO 2						✓	
CO 3	✓						

CO 4	✓						
CO 5	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Set Theory**		**13**
	1	a) Basic Definitions b) Operations on Sets. c) Principle of Inclusion -Exclusion.	
II	**Functions**		**14**
	1	a) Basic Definitions. b) Operations on Functions c) Pigeon hole Principle.	
III	**Comparing Growth Rates of Functions**		**14**
	1	a) A Measure for Comparing Growth Rates b) Properties of Asymptotic Domination. c) Polynomial Functions d) Exponential and Logarithmic Functions	
IV	**Recurrence Relations**		**14**
	1	a) The Tower of Hanoi Problem. b) Solving First - Order Recurrence Relations. c) Fibonacci Recurrence Relation.	
V	**Teacher Specific Module**		**5**
	a) Introduction to Propositional Logic. b) Truth and Logical Truth.		

Essential Readings

1. Gary Haggard, John Schlipf, Sue Whitesides, Discrete Mathematics for Computer Science, Thomson Brooks/Cole.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 1.1, 1.3, 1.5	
II	1	1	Section 4.1, 4.3, 4.6	
III	1	1	Sections 5.1.1, 5.1.2, 5.1.3, 5.1.4	
IV	1	1	Sections 9.1, 9.2, 9.4	
V	1	1	Relevant Topics	

Suggested Readings

1. Seymour Lipschutz, Marc Lars Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, Third edition, McGRAW-HILL
2. Seymour Lipschutz, Schaum's Outlines Set Theory and Related Topics, Second Edition,McGRAW-Hill.
3. Ralph P Grimaldi, Discrete and Combinatorial Mathematics An Applied Introduction, Fifth Edition, Addison-Wesley.
4. V K Balakrishnan, Introductory Discrete Mathematics, Dover Publications, INC.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

****Use of Scientific Calculators below 100 functions (that is, upto*fx 99*) shall be permitted.**

KU3DSCMAT201: ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC		KU3DSCMAT201	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to familiarize the notion of relation and functions and to introduce the basic ideas in theory of equations.

Course Prerequisite

Set theory – basics, equations in single variable

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend the concept of relations and understand different types of relations	Understand
2	Comprehend the concept of functions	Understand
3	Understand the relation connecting the roots and coefficients of equations and the nature and position of roots and to solve equations	Understand
4	Understand symmetric functions of roots of an equation and apply them to solve equations	Understand
5	Comprehend logical concepts and understand quantified statements and truth set	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓	✓	✓			
CO 2	✓	✓	✓	✓			
CO 3	✓		✓				
CO 4	✓		✓				
CO 5	✓	✓		✓			

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Relations and Functions**		14
	1	**Relations**	
		Relations	
		Types of relations	
		Partitions	
		Equivalence relation	
		Partial ordering relation	

	2	**Functions**	
		Functions	
		Composition of functions	
		One-to-one, onto and invertible functions	
		Mathematical functions	
II	**Theory of Equations 1**		**14**
	1	**Roots of equations**	
		Relations connecting the Roots and Coefficients of an Equation	
		Transformation of Equations, Special Cases	
		Character and Position of the Roots of an Equation, Some General Theorems	
		Descarte's rule of signs, Corollaries	
III	**Theory of Equations II**		**14**
	1	Symmetric functions of the roots of an equation	
		Symmetric functions involving only the differences of the roots of f(x)=0	
		Equations whose roots are symmetric functions of α, β and γ	
	2	Reciprocal Equation	
IV	**Logic and Proof**		**13**
	1	**(a) Logic and proofs**	
		(b) Propositional Calculus	
		Propositional functions and truth set	
		Negation of quantified statements	
V	**Teacher Specific Module**		**5**
	Directions		
	Equation whose Roots are the Squares of the Differences of the Roots		
	Character of the Roots of Cubic Equation		
	Cardan's Solution		

Essential Readings

1. S. Lipschutz, Set Theory and Related Topics, Schaum's Outline Series, 2nd edition
2. Higher Algebra, Bernard and Child, AITBS Publishers, Enlarged Edition
3. R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis (4th edition), Wiley

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 3.3, 3.6,3.8,3.9,3.10	
	2	1	Sections 4.1,4.2, 4.3, 4.4, 4.5	Exponential functions and logarithmic functions are excluded from section 4.5
II	1	2	Chapter VI sections 1,2,3,4,7,8,9,10	
III	1	2	Chapter VI sections 15, 16, 17	
	2	2	Chapter XI section 1	Proofs of theorems are excluded from Chapter XI section 1
IV	2 (a)	3	Appendix A	
	2 (b)	1	Sections 10.11, 10.12	

Suggested Readings

1. H.S. Hall and S.R. Knight, Higher Algebra, A.I.T.B.S. Publishers
2. First Course in the theory of equations, Dickson, Leonard E., John Wiley and Sons
3. Theory of equations, Uspensky, James Victor, McGraw-Hill
4. K. H. Rosen, Discrete Mathematics and its Applications, McGraw Hill.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT202
COORDINATE SYSTEMS AND MULTIPLE INTEGRALS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC		KU3DSCMAT202	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to familiarize different coordinate systems and to multiple integrals.

Course Prerequisite

Cartesian coordinate system, integration.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend the concept of polar coordinates and the method of conversion between Cartesian and polar coordinate systems	Understand
2	Understand the method of finding area and length of curves in polar coordinates	Understand
3	Comprehend the concept of double integrals and evaluation of double integrals in Cartesian and polar coordinates	Understand
4	Understand the method of finding area enclosed by curves using double integrals	Understand
5	Comprehend the concept of three-dimensional coordinate system and understand the method of evaluation of triple integrals in Cartesian coordinates	Understand
6	Comprehend the concept of cylindrical and spherical coordinates and understand the evaluation of triple integrals in cylindrical and spherical coordinates	Understand

7	Understand the method of parametrization of curves and comprehend the concepts on cylinders and quadric surfaces	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓		✓	✓		✓	
CO 3	✓		✓				
CO 4	✓		✓	✓		✓	
CO 5	✓		✓				
CO 6	✓		✓				
CO 7	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I	**Polar Coordinates**		**14**
	1	**Polar Coordinates**	
		Polar Coordinates	
		Graphing in Polar Coordinates	
	2	**Areas and Lengths in Polar Coordinates**	
		Areas in Polar Coordinates	
		Lengths in Polar Coordinates	

II	**Multiple Integrals – Double Integral**		**14**
	1	Double and Iterated Integrals over Rectangles	
		Double Integrals over General Regions	
	2	Area by Double Integration	
	3	Double Integrals in Polar Form	
III	**Three-Dimensional Coordinate System and Triple Integrals**		**13**
	1	Three-Dimensional Coordinate Systems	
	2	Triple Integrals in Rectangular Coordinates	
IV	**Cylindrical and Spherical Coordinate Systems and Substitution in Multiple Integrals**		**14**
	1	Triple Integrals in Cylindrical and Spherical Coordinates	
		Substitution in Multiple Integrals	
V		**Teacher Specific Module**	**5**
		Directions	
	1	Parametrizations of Plane Curves	
	2	Cylinders and Quadric Surfaces	

Essential Readings

1. George B. Thomas Jr., Maurice D. Weir, Joel Hass, Thomas' Calculus – Early Transcendentals, Twelfth edition, Addison-Wesley.

Reference Distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 11.3, 11.4	
	2	1	Section 11.5	
II	1	1	Sections 15.1, 15.2	
	2	1	Section 15.3	
	3	1	Section 15.4	
III	1	1	Sections 12.1 and 15.5	

IV	1	1	Section 15.7	
	2	1	Section 15.8	
V	1	1	Section 11.1	
	2	1	Section 12.6	

Suggested Readings

1. Calculus, Anton, Bivens and Davis, Wiley Student Edition
2. J Stewart. Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited
3. Integral Calculus, Shanti Narayan & P.K. Mittal, S. Chand.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT211
DIFFERENTIAL EQUATIONS, LAPLACE TRANSFORMS, LINEAR PROGRAMMING AND NUMERICAL METHODS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCMAT211	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces computer application students to fundamental mathematical topics differential equation, Laplace transforms, linear programming, and numerical methods.

Course Prerequisite

Derivatives, integrals.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Methods of solving Differential Equations: Separable ODEs, Exact ODEs, Integrating Factors, Linear ODEs.	Understand
2	Understand Laplace Transform, Linearity, first shifting theorem, Transforms of Derivatives and transform of integrals.	Apply
3	Understand the definition of Linear Programming Problems (LPP), differentiate between canonical and standard forms, and apply graphical and simplex methods for solution.	Understand
4	Apply numerical methods for solving algebraic and transcendental equations, including bisection, false position, Newton-Raphson, and numerical integration techniques like the trapezoidal and Simpson's 1/3 rule.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓	✓	✓			
CO 2		✓	✓		✓		
CO 4		✓	✓			✓	
CO 5	✓		✓	✓			

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**First Order Ordinary Differential Equations**	
	1	Basic Concepts. Modeling	13
	2	Separable ODEs	
	3	Exact ODEs. Integrating Factors	
	4	Linear ODEs.	
II		**Laplace transforms**	14
	1	Laplace Transform, Linearity, First Shifting Theorem (s-Shifting)	
	2	Transforms of Derivatives, transform of integrals, ODEs	
III		**Linear Programming**	14
	1	Introduction	
	2	Requirements of linear programming problem	
	3	Areas of application of linear programming	
	4	Graphical method of solution	
	5	Canonical and standard form of linear programming problem	
	6	The simplex method (Technique and algorithm)	
IV		**Numerical Methods**	14
	1	**Solution of algebraic and transcendental equations**	
		a) Introduction	
		b) Bisection Method	
		c) Newton Raphson method	
	2	**Numerical integration**	
		a) Trapezoidal rule	
		b) Simpsons 1/3 rule	
V		**Teacher Specific Module**	**5**
		Directions	
		Formulation of linear programming problems (Module III, Section 2.6.1, 2.6.2, 2.6.3, 2.6.4)	
		Application of the some renowned Numerical Methods. (Module IV)	
		Differential equations, solution of ODEs	

Essential Readings

1. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley, 2015
2. Operations Research (Revised Edition) Er. Prem Kumar Gupta and Dr. D.S. Hira
3. Introductory Methods of Numerical Analysis (5th edition), S.S. Sastry PHI Learning

Reference Distribution

Module	Unit	Reference No.	Page Nos.	Remarks
I	1	1	1.1	More on Modeling excluded
	2	1	1.3	Modeling excluded
	3	1	1.4	Theorems and proof excluded
	4	1	1.5	Population Dynamics excluded
II	1	1	6.1	Existence and Uniqueness of Laplace Transforms excluded
	2	1	6.2	Differential Equations, Initial Value Problems excluded
III	1	2	2.1	
	2	2	2.2	
	3	2	2.5	
	4	2	2.9	Examples2.9-8,2.9-10,2.9-11 are excluded
	5	2	2.12	
	6	2	2.16	Algorithm excluded in the end semester examination
IV	1	3	2.1, 2.2, 2.5	
	2	3	6.4.1, 6.4.2	

Suggested Readings

1. Operations Research (18th thoroughly revised edition), Kantiswaroop, P.K. Gupta and Manmohan, Sultan Chand & Sons.
2. Numerical Analysis (3rd Edition), Timothy Sauer, Pearson

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT212
BASIC MATHEMATICAL METHODS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCMAT212	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course consists of the topics Fourier series, first and second order ordinary differential equations, linear algebra and numerical analysis.

Course Prerequisite

Familiarity with calculus, matrices and determinants.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Fourier series	Understand
2	Comprehend first order ordinary differential equations and methods to solve them	Understand
3	Comprehend second order ordinary differential equations and methods to solve them	Understand
4	Use Gauss elimination method and Cramer's rule to find solution of linear system of equations	Understand
5	Use Gauss-Jordan method to find inverse of a matrix	Understand
6	Understand eigenvalues and eigenvectors of matrices	Understand
7	Understand numerical integration	Understand
8	Understand numerical solution of ordinary differential equations	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓			✓			
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						
CO 8	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Fourier Series**		13
	1	**Fourier Series**	
		(a) Fourier series	
		(b) Arbitrary period	
		(c) Even and Odd functions	

II	**Differential Equations**		**14**
	1	**First Order Ordinary Differential Equations**	
		(a) Basic concepts	
		(b) Separable ODEs (modeling excluded)	
		(c) Exact ODEs	
		(d) Integrating Factors	
		(e) Linear ODEs	
	2	**Second Order Ordinary Differential Equations**	
		(a) Homogeneous Linear ODEs of second order	
		(b) Homogeneous Linear ODEs with constant coefficients	
III	**Linear Algebra**		**14**
	1	**Linear system of equations**	
		(a) Linear system of equations, Gauss elimination	
		(b) Determinants, Cramer's rule	
		(c) Inverse, Gauss-Jordan elimination	
	2	**Cayley-Hamilton theorem**	
IV	**Numerical Analysis**		**14**
	1	**Numerical integration**	
		(a) Trapezoidal rule	
		(b) Simpson's 1/3 rd rule	
	2	**Numerical solution of ordinary differential equations**	
		(a) Euler's method	
		(b) Runge-Kutta methods	
V	**Teacher Specific Module**		**5**
	Laplace Transform, Linearity, First shifting theorem (*s*-Shifting)		

Essential Readings

1. Kreyszig, E. *Advanced Engineering Mathematics* (10th ed.) (2011), Wiley.
2. Grewal, B. S. *Higher Engineering Mathematics* (43rd ed.) (2015), Khanna Publishers.
3. Iyengar S.R.K. and Jain R.K., Mathematical Methods (2nd edition) (2013), Narosa Publishing House.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 11.1, 11.2	*Half range expansion in section 11.2 is excluded*
II	1	1	Sections 1.1, 1.3, 1.4, 1.5	*Modelling in Section 1.3 and population dynamics in section 1.5 are omitted.*
	2	1	Section 2.1, 2.2	*All Proofs are omitted*
III	1	1	Sections 7.3, 7.7, 7.8	*Theorem 3 in Section 7.8 is omitted. All Proofs are also omitted*
	2	2	Section 2.15	*All Proofs are omitted*
IV	1	3	Sections 6.3, 6.3.1, 6.3.2	
	2	3	Sections 7.4, 7.5	

Suggested Readings

5. Anton, H., Bivens, I., & Davis, S. (2012). *Calculus* (10th ed.). Wiley.
6. Stewart, J. (2015). *Calculus: Early Transcendentals* (8th ed.). Cengage Learning.
7. Chapra, S. C., & Canale, R. P. (2014). *Numerical Methods for Engineers* (7th ed.). McGraw-Hill Education.
8. Adams, R. A., & Essex, C. (2013). *Calculus: A Complete Course* (8th ed.). Pearson
9. Narayan S. and Mittal P.K., A Text Book of Matrices (Revised edition), S. Chand.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT213
GRAPH THEORY, LINEAR PROGRAMMING AND NUMERICAL METHODS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCMAT213	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces students to fundamental mathematical topics such as graph theory, linear programming, and numerical methods. These areas play a vital role in algorithm design, data analysis, optimization, and modelling complex systems. Graph theory is explored for network analysis and data structure applications, while linear programming tackles resource allocation and logistics optimization. Numerical methods are studied for their efficiency in solving mathematical problems across scientific and engineering domains. Through this course, students develop algorithmic skills, learn to design efficient systems, and apply computational approaches to real-world problem-solving, enhancing their analytical and problem-solving capabilities.

Course Prerequisite

Differential equations

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of graph theory, encompassing graph types, isomorphism, subgraph concepts, and their applications in problem-solving.	Understand
2	Apply graph operations like union, intersection, and induced subgraphs to analyse and manipulate graph structures effectively.	Apply
3	Understand the definition of Linear Programming Problems (LPP), differentiate between canonical and standard forms, and apply graphical and simplex methods for solution.	Apply
4	Understand and apply numerical methods for solving algebraic and transcendental equations, including bisection, false position, Newton-Raphson, and numerical integration techniques like the trapezoidal and Simpson's 1/3 rule.	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2				✓			
CO 3	✓			✓			
CO 4	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Introduction to Graphs and Operations on Graphs**	
	1	Introduction	13
		a) What is a Graph?	
		b) Applications of Graphs	
	2	Incidence and Degree	
	3	Isolated Vertex, Pendant Vertex, and Null Graph	
	4	a) Isomorphism	
		b) Sub graphs	
II		**Connected Graphs**	
	1	Walks, Paths and Circuits	14
	2	Connected Graphs, Disconnected Graphs and Components	
	3	Operations on Graphs	
	4	Incidence Matrix (Definition and Examples Only)	
	5	Adjacency Matrix (Definition and Examples Only)	
III		**Linear Programming**	14
	1	Introduction	
	2	Requirements of Linear Programming Problem	
	3	Areas of Application of Linear Programming	
	4	Graphical Method of Solution	
	5	Canonical and Standard form of Linear Programming Problem	
	6	The Simplex Method	
IV		**Numerical Methods**	14

	1	**Solution of Algebraic and Transcendental Equations**	
		a) Introduction	
		b) Bisection Method	
		c) Newton Raphson Method	
	2	**Numerical Integration**	
		a) Trapezoidal Rule	
		b) Simpsons 1/3 Rule	
V		**Teacher Specific Module**	**5**
		Directions	
		A Puzzle with Multi-coloured Cubes (Unit 4 in Module 1, Section 2.3)	1
		Formulation of linear programming problems (Module 3, Section 2.6.1, 2.6.2, 2.6.3, 2.6.4)	2
		Applications of some renowned Numerical Methods. (Module 4)	2

Essential Readings

1. Graph Theory with Applications to Engineering and Computer Science by Narsingh Deo
2. Operations Research (Revised Edition) Er. Prem Kumar Gupta and Dr. D.S. Hira
3. Introductory Methods of Numerical Analysis (5^{th} edition), S.S. Sastry PHI Learning.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	1.2, 1.2	
	2	1	1.4	
	3	1	1.5	
	4	1	2.1, 2.2	
II	1	1	2.4	
	2	1	2.5	
	3	1	2.7	
	4	1	7.1	Definition and Examples Only
	5	1	7.9	Definition and Examples Only
III	1	2	2.1	
	2	2	2.2	
	3	2	2.5	
	4	2	2.9	Examples2.9-8, 2.9-10, 2.9-11 are excluded
	5	2	2.12	

	6	2	2.16	Algorithm excluded in the end semester examination
IV	1	3	2.1, 2.2, 2.5	
	2	3	6.4.1, 6.4.2	

Suggested Readings

3. A First Look at Graph Theory, John Clark and Derek Allan Holton, Allied Pub.
4. Operations Research (18th thoroughly revised edition), Kantiswaroop, P.K. Gupta and Manmohan, Sultan Chand & Sons.
5. Numerical Analysis (Third Edition), Timothy Sauer, Pearson.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT214
APPLIED DIFFERENTIAL AND DIFFERENCE EQUATIONS IN ECONOMIC ANALYSIS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	100	KU3DSCMAT214	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course provides a thorough exploration of first and second-order differential and difference equations, covering their definitions, formulas, and applications in economic analysis.

Course Prerequisite

Familiarity with calculus, matrix algebra, and basic economics concepts.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concept of functions of several variables and compute partial derivatives.	Understand
2	Apply rules of partial differentiation to solve problems involving multivariable functions.	Apply
3	Understand and compute differentials and total derivatives of multivariable functions.	Understand
4	Distinguish between total and partial differentials and compute total derivatives for economic models.	Understand
5	Apply optimization techniques to multivariable functions in economic contexts.	Apply
6	Solve constrained optimization problems using Lagrange multipliers.	Apply

7	Understand the implications of Lagrange multipliers in identifying optimal economic outcomes.	Understand
8	Use the Jacobian to analyse transformations and dependencies among economic variables.	Apply
9	Apply discriminants to determine the nature of critical points in constrained optimization.	Apply
10	Use matrices, including input-output models and characteristic roots/vectors, to analyse economic systems.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4		✓				✓	
CO 5	✓						
CO 6		✓				✓	
CO 7		✓				✓	
CO8	✓						
CO9			✓				
CO10				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Calculus of Multivariable Functions I**	14
	1	(a) Functions of Several Variables and Partial Derivatives	
		(b)Rules of Partial Differentiation	
		(c) Second-Order Partial Derivatives	
		(d) Differentials	
		(e) Total and Partial Differentials	
		(f)Total Derivatives	
II		**Calculus of Multivariable Functions II**	14
	1	(a) Optimization of Multivariable Functions	
		(b) Constrained Optimization	
		(c) Constrained Optimization with Lagrange Multiplier	
		(d) Significance of the Lagrange Multiplier	
		(e) Implicit and Inverse Function Rules	
III		**First order differential equations**	13
	1	a) Definitions and Concepts	
		b) General formula for first order linear differential equation	
		c) Exact differential equation and partial integration	
		(d) Separation of variables	

IV		**Special Determinants and Matrices and their Use in Economics**	14
	1	a) The Jacobian	
		b) The Discriminant	
		c) Input-Output Analysis	
		d) Characteristic Roots and Characteristic Vectors	

V	**Teacher Specific Module**	5
	Directions	
	Calculus of variation: Dynamic optimization, Distance between two points on plane, Euler equation, Finding candidates for extremals, vibrational notation, Dynamic optimization subject to functional constraints Application to economics.	

Essential Readings

1. Edward T. Dowling, Introduction to Mathematical Economics (3rd Edition), Schaum's Outline Series, McGraw-Hill International Edition.

Reference Distribution

Module	Unit	Reference No.	Chapter/Section	Remarks
I	1	1	Sections 5.1, 5.2, 5.3, 5.7, 5.8, 5.9	
II	1	1	Sections 5.4, 5.5. 5.6, 5.10	
III	1	1	Section 16.1,16.2, 16.3, 16.6	*Problems 16.45,16.46,16.47 are excluded* .
IV	1	1	Section 12.1, 12.3, 12.6, 12.7	

Suggested Readings

1. Srinath Barauh (2010). "Basic Mathematics and Its Application in Economics." Amanad, New Delhi.
2. Peter J. Hammond & Knut Sydsaeter (2010). "Mathematics for Economic Analysis." Pearson.
3. Allen R.G.D (1956). "Mathematical Analysis for Economists." Macmillan.
4. Yamane, Taro (2004). "Mathematics for Economists: An Elementary Survey." PHI, New Delhi.
5. Chiang, A.C (1988). "Fundamental Methods of Mathematical Economics." McGraw Hill.
6. Anton, H., Bivens, I., & Davis, S. (2012). "Calculus" (10th ed.). Wiley.
7. Grewal, B. S. (2015). "Higher Engineering Mathematics" (43rd ed.). Khanna Publishers.
8. Narayan, S., & Mittal, P. K. (2014). "Differential Calculus" (Revised ed.). S. Chand & Company Ltd.
9. Kreyszig, E. (2011). "Advanced Engineering Mathematics" (10th ed.). Wiley.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT215
DIFFERENTIAL EQUATIONS, LAPLACE TRANSFORMS AND FOURIER SERIES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200	KU3DSCMAT215	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers the advanced topics first and second-order ordinary differential equations, Laplace transforms and Fourier series.

Course Prerequisite

Familiarity with Calculus.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend first order ordinary differential equations and methods to solve them	Understand
2	Comprehend second order ordinary differential equations and methods to solve them	Apply
3	Apply differential equations to model real-world problems.	Apply
4	Apply Laplace transforms to solve differential equations	Apply
5	Understand Fourier series	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓			✓			
CO 4	✓		✓				
CO 5	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**First Order Ordinary Differential Equations**	14
	1	(f) Basic concepts	
		(g) Separable ODEs (modelling excluded)	
		(h) Exact ODEs	
		(i) Linear ODEs	
II		**Second Order Ordinary Differential Equations**	14
	1	(c) Homogeneous Linear ODEs of second order	
		(d) Homogeneous Linear ODEs with constant coefficients	
		(e) Differential Operators	
		(f) Existence and Uniqueness of Solutions – Wronskian (statements of Theorems only, proofs are omitted)	
		(g) Solution by variation of Parameters	
III		**Laplace Transforms and its applications**	14
	1	(a) Laplace Transform	
		(b) Linearity	
		(c) First shifting theorem (*s*-Shifting)	
		(d) Transforms of Derivatives and Integrals	
		(e) ODEs	
IV		**Fourier Series**	13
	1	(d) Fourier series	
		(e) Arbitrary period	
		(f) Even and Odd functions	
V		**Teacher Specific Module**	5
		Integrating factor	
		Bernoulli’s equation	
		Nonhomogeneous ODE	

Essential Readings

4. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 1.1, 1.3, 1.4, 1.5	
II	1	1	Sections 2.1, 2.2, 2.3, 2.6, 2.10	
III	1	1	Sections 6.1, 6.2	*Proofs are omitted*
IV	1	1	Sections 11.1, 11.2, 11.3	*Proofs are omitted. Half-Range expansions are omitted.*

Suggested Readings

10. Anton, H., Bivens, I., & Davis, S. (2012). *Calculus* (10th ed.). Wiley.
11. Grewal, B. S. (2015). *Higher Engineering Mathematics* (43rd ed.). Khanna Publishers.
12. Iyengar, S. R. K., & Jain, R. K. (2012). *Mathematical Methods* (3rd ed.). Alpha Science International Ltd.
13. Stewart, J. (2015). *Calculus: Early Transcendentals* (8th ed.). Cengage Learning.
14. Chapra, S. C., & Canale, R. P. (2014). *Numerical Methods for Engineers* (7th ed.). McGraw-Hill Education.
15. Adams, R. A., & Essex, C. (2013). *Calculus: A Complete Course* (8th ed.). Pearson

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT216
TRANSFORMS, LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCMAT216	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers advanced mathematical concepts including Fourier series, Laplace transforms, ordinary differential equations, linear algebra, eigenvalues and eigenvectors, and partial differential equations.

Course Prerequisite

A solid understanding of calculus including integration and differentiation, basic concepts of matrix and ordinary differential equations

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Students will understand and construct Fourier series for periodic functions, including arbitrary periods and half-range expansions	Understand
2	Students will perform Laplace transforms, apply linearity, and use general formulas effectively.	Understand
3	Students will master linear algebra operations, solve linear systems using Gauss elimination, and understand determinants, Cramer's Rule, and matrix inverses.	Understand

4	Students will determine eigenvalues and eigenvectors, solve matrix eigenvalue problems	Understand
5	Students will understand and solve basic PDEs by separating variables and Fourier series, including specific solutions for the wave and heat equations.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1		✓					
CO 2		✓					
CO 3	✓						
CO 4	✓						
CO 5					✓		

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I	**Fourier Series**		**13**
	1	**Fourier Series**	
		(a) Fourier Series	
		(b) Functions of Any Period $p=2L$	
		(c) Even and Odd Functions. Half-Range Expansions	
II		**Laplace Transforms**	**14**
	1	a) Laplace Transform, Linearity, First Shifting Theorem (s-Shifting)	
		b) Transforms of Derivatives, transform of integrals, ODEs	

<table>
<tr><td rowspan="7">III</td><td colspan="2">Linear Algebra</td><td rowspan="5">14</td></tr>
<tr><td rowspan="4">1</td><td>Linear Systems of Equations</td></tr>
<tr><td>a) Linear Systems of Equations. Gauss Elimination</td></tr>
<tr><td>b) Determinants. Cramer’s Rule</td></tr>
<tr><td>c) Inverse of a Matrix. Gauss–Jordan Elimination</td></tr>
<tr><td colspan="2">2 Eigenvalues, Eigenvectors</td><td rowspan="7">14</td></tr>
<tr><td></td><td>a) The Matrix Eigenvalue Problem. Determining Eigenvalues and Eigenvectors</td></tr>
<tr><td rowspan="5">IV</td><td colspan="2">Partial Differential Equations</td></tr>
<tr><td rowspan="4">1</td><td>a) Basic Concepts of PDEs</td></tr>
<tr><td>b) Solution by Separating Variables. Use of Fourier Series</td></tr>
<tr><td>c) D’Alembert’s Solution of the Wave Equation.</td></tr>
<tr><td>d) Heat Equation: Solution by Fourier Series</td></tr>
<tr><td rowspan="3">V</td><td colspan="2">Teacher specific module</td><td rowspan="3">5</td></tr>
<tr><td>1</td><td>Existence and uniqueness of solution of linear systems</td></tr>
<tr><td>2</td><td>Cayley Hamilton theorem</td></tr>
</table>

Essential Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics (10th edition)

Reference Distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 11.1,11.2, 11.3	*Proofs are excluded*
II	1	1	Sections 6.1, 6.2	*Proofs are excluded*
III	1	1	Section 7.3, 7.7, 7.8	
	2	1	Section 8.1	
IV	1	1	Section 12.1, 12.3, 12.4, 12.6	*Proofs are excluded*

Suggested Readings

1. Higher Engineering Mathematics, B.S. Grewal (43rd edition), Khanna Publishers
2. S.L. Ross, Differential Equations, 3rd Edition, Wiley.
3. G. Birkhoff and G.C. Rota, Ordinary Differential Equations, Wiley and Sons, 3rd Edition
4. E.A. Coddington, An Introduction to Ordinary Differential Equtions, Printice Hall
5. W.E. Boyce and R.C.Diprima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. The average mark of the best two tests is to be considered for the internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU3DSCMAT217
MULTIPLE INTEGRALS, DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCMAT217	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers advanced topics including multiple integrals, first and second-order differential equations, solution of algebraic and transcendental equations, numerical integration, and numerical solutions of first-order ordinary differential equations. Students will learn techniques for evaluating integrals, solving ODEs, and using numerical methods such as bisection, trapezoidal rule, Euler method and Runge-Kuta method.

Course Prerequisite

Familiarity with calculus.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand concepts of double and triple integrals over various regions, both in Cartesian and polar coordinates.	Understand
2	Apply Fubini's theorem to compute double integrals	Apply
3	Apply properties of double and triple integrals to find areas and volumes.	Apply
4	Analyse differential equations and their solutions to model real-world problems.	Analyse
5	Apply numerical methods to solve algebraic and transcendental equations	Apply
6	Apply numerical integration techniques to obtain approximate values of integrals.	Apply
7	Apply the numerical techniques for solving differential equations	Apply

8	Apply different numerical techniques to solve practical problems in various branches of science and technology	Apply
9	Apply Trapezoidal rule to obtain area under the curve	Apply
10	Apply Euler method to solve first order differential equations.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4			✓	✓			
CO 5	✓				✓		
CO 6	✓				✓		
CO 7	✓				✓		
CO8			✓	✓			
CO9	✓				✓		
CO10	✓				✓		

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Multiple Integral – I**		14
	1	**Double and iterated integrals over rectangles**	
		(a) Double integral	
		(b) Double integral as volume	
		(c) Fubini's theorem for calculating double integral (first form)	

	2	**Double integrals over general regions**	
		(a) Double integral over bounded and nonrectangular regions	
		(b) Volumes	
		(c) Fubini's theorem (Stronger form)	
		(d) Finding limit of integration	
		(e) Properties of double integrals	
II	**Multiple Integral – II**		12
	1	**Polar co-ordinates**	
		(a) Definition of polar coordinate	
		(b) Polar equation and graphs	
		(c) Equations relating polar and Cartesian coordinates	
	2	**Integrals in polar co-ordinates**	
		(a) Area in polar co-ordinates	
		(b) Changing Cartesian integrals to polar integrals	
	3	**Triples integrals**	
		(a) Triples integrals in rectangular coordinates	
		(b) Volume of region in space	
		(c) Finding limit of integration	
		(d) Average value of function in space	
III	**Ordinary differential equations**		**13**
	1	**First order ordinary differential equation**	
		(a) Basic concepts	
		(b)) Separable ODEs	
		(c) Exact ODEs	
	Second order ordinary differential equation		
	2	e) Homogeneous linear ODE's of second order	
		f) Homogeneous Linear ODEs with Constant Coefficients	
IV	**Numerical Methods**		**14**
	1	**Solution of algebraic and transcendental equations**	
		(a) Introduction	
		(b) Bisection method	
		(c) Method of false position	
	2	**Numerical integration**	
		(a) Trapezoidal rule	

		(b) Simpsons 1/3 rule	
	3	**Numerical solutions of ordinary differential equations**	
		(a) Euler method	
		(b) Euler modified method	
		(c) Runge-Kuta method (2^{nd} order only)	
V	**Teacher Specific Module**		**5**
	Directions		
	First order ODE: Linear ODE’s, Bernoulli equations		
	Triple integral in Cylindrical and spherical coordinates, Substitution in multiple integrals		

Essential Readings

1. Thomas, G. B., Weir, M. D., & Hass, J. R. (2010). *Thomas' Calculus: Early Transcendentals* (12^{th} ed.). Pearson Education.
2. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10^{th} ed.). Wiley.
3. Sastry, S. S. (2012). *Introductory Methods of Numerical Analysis* (5^{th} ed.). PHI Learning.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	15.1	
	2	1	15.2	
II	1	1	11.3	
	2	1	15.4	
	3	1	15.5	
III	1	2	1.1, 1.3, 1.4	Modeling and related problems, proofs of results, and derivations are excluded in all sections.
	2	2	2.1, 2.2	
IV	1	3	2.1, 2.2, 2.3	Proofs and derivations are excluded in all sections
	2	3	6.4, 6.4.1, 6.4.2	
	3	3	8.4, 8.4.2, 8.5	

Suggested Readings

1. Anton, H., Bivens, I., & Davis, S. (2012). *Calculus* (10^{th} ed.). Wiley.
2. Grewal, B. S. (2015). *Higher Engineering Mathematics* (43^{rd} ed.). Khanna Publishers.
3. Narayan, S., & Mittal, P. K. (2014). *Differential Calculus* (Revised ed.). S. Chand & Company Ltd.

4. Iyengar, S. R. K., & Jain, R. K. (2012). *Mathematical Methods* (3rd ed.). Alpha Science International Ltd.
5. Stewart, J. (2015). *Calculus: Early Transcendentals* (8th ed.). Cengage Learning.
6. Burden, R. L., & Faires, J. D. (2011). *Numerical Analysis* (9th ed.). Brooks/Cole.
7. Chapra, S. C., & Canale, R. P. (2014). *Numerical Methods for Engineers* (7th ed.). McGraw-Hill Education.
8. Adams, R. A., & Essex, C. (2013). *Calculus: A Complete Course* (8th ed.). Pearson+

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU4DSCMAT201
ANALYTIC GEOMETRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200-299	KU4DSCMAT201	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course provides a comprehensive study of the geometry of the plane and space using a coordinate system. Students will explore the relationship between algebra and geometry through the use of the Cartesian coordinate system to represent geometric figures and solve geometric problems. Topics include the study of lines, parabolas, ellipses, and hyperbolas, as well as the use of vectors and three-dimensional geometry. Emphasis is placed on developing problem-solving skills, logical reasoning, and mathematical precision.

Course Prerequisite

Cartesian coordinates, lines in two dimension, first and second order derivatives of functions, dot and cross product of vectors.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	To understand alternative ways of expressing curves in the plane.	Understand
2	To analyze and understand basic properties of conic sections.	Understand
3	To comprehend techniques to find tangents, normal and curvature of plane curves	Apply
4	To understand lines and planes in space	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✔						
CO 2	✔		✔				
CO 3	✔						
CO 4	✔						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Parametric Equations**	14
	1	Parametric Equations. (Example 1 Exempted)	
	2	Orientation.	
	3	Expressing Ordinary functions parametrically.	
	4	Tangent Lines to Parametric Curves.	
	5	Arc Length for Parametric Curves.	
	6	The cycloid (Definition and brief description only).	
II		**Conic Sections**	
	1	Definitions of Conic Sections	14
	2	Equations of Parabolas in Standard Positions	
	3	Equations of Ellipses in Standard Positions	
	4	Equations of Hyperbolas in Standard Positions	
III		**Tangents, Normals and Curvature**	
	1	**Tangents and Normals** Equation of the tangent, Equation of the normal, Angle of intersection of two curves.	13
	2	**Curvature** Curvature, Radius of curvature, Centre of curvature	
IV		**Lines and Planes in Space**	
	1	**Lines** Lines and line segments in space, Distance from a point to a line in space	14
	2	**Planes** Equation for a Plane in space, Line of intersection of two planes, Distance from a point to a plane, Angle between two planes.	
V		**Teacher Specific Module**	**5**
		Graphs in Polar Coordinates	
		Sketching a Parabola from Its Standard Equation, Sketching an Ellipse from Its Standard Equation, Sketching a Hyperbola from Its Standard Equation. Sketching Conics in Polar Coordinates.	

Essential Readings

1. Calculus : Early Transcendentals, Howard Anton, Irl Bivens, Stephen Davis, 10th Edition
2. Higher Engineering Mathematics, B.S. Grewal (44th edition), Khanna Publishers
3. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education

Reference Distribution

Module	Unit	Reference No.	Section Nos	Page Nos.	Remarks
I	1	1	10.1	692	*Example 1 exempted*
	2	1	10.1	694	
	3	1	10.1	694	
	4	1	10.1	695	
	5	1	10.1	697	
	6	1	10.1	698	*Definition and brief description only.*
II	1, 2, 3, 4	1	10.4	730 - 740	
III	1	2	4.6(1), (2), (3)		
	2	2	4.10 4.11(1), (2), (3) 4.12(1)		
IV	1, 2	3	12.5		

Suggested Readings

1. S.L. Loney, The Elements of Coordinate Geometry, Patr I, AITBS Publishers
2. Jain, P.K., Textbook of Analytical Geometry
3. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Wiley
4. S. Narayan and P.K. Mittal, Differential Calculus (Revised edition), S, Chand & Co. Pvt Ltd.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU4DSCMAT202
NUMBER THEORY AND COMPLEX NUMBERS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200-299	KU4DSCMAT202	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is designed to provide an in-depth understanding of several fundamental topics in number theory and also give an introduction to complex numbers.

Course Prerequisite

Basics of number system.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Division algorithm, Greatest common Divisor, Euclidean Algorithm, Diophantine equation $ax+by=c$.	Understand
2	Understand Primes and their distribution, fundamental theorem of arithmetic, the sieve of Eratosthenes	Understand
3	Explain the concept of congruence	Understand
4	Understand Fermat’s little theorem, Wilson’s theorem, Euler’s phi-function and Euler’s theorem	Understand
5	Remember the concepts of complex numbers and their algebraic operation	Remember
6	Understand Roots of complex numbers	Understand
7	Understand polar form of complex numbers, powers and roots.	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						

CO 5	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Divisibility Theory in Integers**		**14**
	1	Division algorithm	
	2	Greatest common Divisor	
	3	Euclidean Algorithm	
	4	Diophantine equation $ax+by=c$	
II	**Primes and their distribution, Congruences**		**13**
	1	Fundamental theorem of Arithmetic	
	2	The sieve of Eratosthenes	
	3	Basic properties of congruence	
III	**Fermat’s Theorem**		**14**
	1	Fermat’s Little theorem and pseudo primes	
	2	Wilson’s theorem	
	3	Euler’s phi- function	
	4	Euler’s theorem	
IV	**Complex Numbers**		**14**
	1	Quick review of Complex number, equality of complex numbers, fundamental operations, zero product, geometrical representation of complex numbers, addition and subtraction, product and quotients, conjugate numbers	
	2	Roots of complex numbers, General form of De Moivre’s theorem, the n^{th} roots of unity, the n^{th} roots of -1, Factors of $x^n -1$ and $x^n +1$, the imaginary cube roots of unity	
	3	Polar form of complex numbers, powers and roots	
V	**Teacher Specific Module**		**5**
	Directions		
	Linear Congruence and the Chinese Remainder theorem		

Essential Readings

1. David M Burton, Elementary Number theory,7th edition, Mc Graw Hill
2. Bernard and Child, Higher Algebra, A.I.T.B.S. Publishers
3. E. Kreyszig, Advanced Engineering Mathematics (10th edition), Wiley.

Reference Distribution

<table>
<tr><th>Module</th><th>Unit</th><th>Reference No.</th><th>Sections</th><th>Remarks</th></tr>
<tr><td rowspan="4">I</td><td>1</td><td>1</td><td>Section 2.2</td><td>Proof of division algorithm omitted</td></tr>
<tr><td>2</td><td>1</td><td>Section 2.3</td><td></td></tr>
<tr><td>3</td><td>1</td><td>Section 2.4</td><td></td></tr>
<tr><td>4</td><td>1</td><td>Section 2.5</td><td></td></tr>
<tr><td rowspan="3">II</td><td>1</td><td>1</td><td>Section 3.1</td><td></td></tr>
<tr><td>2</td><td>1</td><td>Section 3.2</td><td></td></tr>
<tr><td>3</td><td>1</td><td>Section 4.2</td><td></td></tr>
<tr><td rowspan="4">III</td><td>1</td><td>1</td><td>Section 5.2</td><td rowspan="4">Proofs of Fermat’s, Wilson’s and Euler’s theorems excluded</td></tr>
<tr><td>2</td><td>1</td><td>Section 5.3</td></tr>
<tr><td>3</td><td>1</td><td>Section 7.2</td></tr>
<tr><td>4</td><td>1</td><td>Section 7.3</td></tr>
<tr><td rowspan="3">IV</td><td>1</td><td>2</td><td>Sections 1 to14 of chapter V</td><td>Questions should not be included in the End Semester Examination from these topics for Quick review</td></tr>
<tr><td>2</td><td>2</td><td>Sections 15 to 20 of chapter V</td><td></td></tr>
<tr><td>3</td><td>3</td><td>Section 13.2</td><td></td></tr>
</table>

Suggested Readings

1. T.M. Apostol, Introduction to Analytic Number Theory, Springer
2. N. Koblitz, A Course in Number theory and Cryptography (2nd edition), Springer
3. B.S. Grewal, Higher Engineering Mathematics (43rd edition), Khanna Publishers.
4. H.S. Hall and S.R. Knight, Higher Algebra, A.I.T.B.S. Publishers.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU4DSCMAT203
ORDINARY DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200-299	KU4DSCMAT203	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4			30	70	100	2

Course Description

This course discusses First Order ODE, Second Order ODE and Laplace Transforms.

Course Prerequisite

Differentiation and Integration of functions.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend the concept of Differential Equations	Understand
2	Classifies the differential equations with respect to their order and linearity	Apply
3	Comprehend the meaning of solution of a differential equation	Understand
4	Comprehend particular solution of IVP	Understand
5	Comprehend the existence-uniqueness theorem of differential equations	Understand
6	Recognise an appropriate solution method for a given problem and solves	Apply
7	Comprehend the concept of Laplace Transformation	Understand
8	Use Laplace Transforms for solving IVPs	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2			✓				
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6			✓				
CO 7	✓						
CO 8			✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS**	14
	1	**Basic concepts**	
		a) Differential Equations, Order of an ODE, Explicit form, Implicit form	
		b) Concept of solution, Verification of solution	
		c) Initial Value Problems	
	2	**Separable ODEs**	
		a) Reduction to separable form	
	3	**Exact ODEs**	
		a) Integrating factors	
		b) Reduction to Exact form	

	4	**Linear ODEs**	
		a) Standard form, Homogeneous and nonhomogeneous Linear ODE	
		b) Solution of Linear ODE	
		c) Bernoulli Equation, Reduction to Linear Form	
	5	**Existence and Uniqueness of Solutions for Initial Value Problems**	
II	**Second Order Linear ODES**		**14**
	1	**Homogeneous Linear ODEs of Second Order**	
		a) Homogeneous Linear ODE, Superposition Principle	
		b) Initial Value Problem, Basis, General Solution	
		c) Finding a Basis if one solution is known	
	2	**Homogeneous ODEs with constant coefficients**	
	3	**Differential Operators**	
	4	**Euler-Cauchy Equations**	
	5	**Existence and Uniqueness of solutions** a) Wronskian b) Linear Dependence and Independence of solutions c) Existence of a general solution	
	6	**Nonhomogeneous ODEs** a) Method of Undetermined Coefficients b) Solution by Variation of Parameters	
III	**Laplace Transform I**		**14**
	1	**Laplace Transform** a) Definition b) Notation c) Laplace Transform of some simple functions d) Linearity e) First shifting Theorem	
	2	**Transforms of Derivatives and Integrals** a) Laplace Transform of Derivatives b) Laplace Transform of Integrals c) Solution of IVP using Laplace Transform	
IV	**Laplace Transform II**		**13**
	1	**Unit Step Function** a) Second Shifting Theorem	
	2	**Short Impulses, Dirac Delta Function, Partial Fractions**	
	3	**Convolution and Integral Equations** a) Convolution Theorem b) Application to Nonhomogeneous Linear ODEs c) Integral Equations	

V	**Teacher Specific Module**			5
	Directions			
	1	Modelling		
	2	Orthogonal Trajectories		
	3	Higher Order ODEs		

Essential Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Willey

Reference Distribution

Module	Unit	Reference No.	Page Nos.	Remarks
I	1	Section 1.1	2-6	Example 5 omitted
	2	Section 1.3	12-18	
	3	Section 1.4	20-26	
	4	Section 1.5	27-32	
	5	Section 1.7	38-42	
II	1	Section 2.1	46-53	
	2	Section 2.2	53-59	
	3	Section 2.3	60-61	
	4	Section 2.5	71-73	
	5	Section 2.6	74-79	
	6	Sections 2.7, 2.10	79-84, 99-102	
III	1	Sections 6.1	204-210	
	2	Sections 6.2	211-216	
IV	1	Section 6.3	217-223	
	2	Section 6.4	225-230	
	3	Sections 6.5	232-237	

Suggested Readings

1. S.L Ross, Differential Equations,3rd edition, Wiley
2. G Birkhoff and G C Rota, Ordinary Differential Equations, 3rd edition, Wiley and Sons
3. E A Coddington, An Introduction to Ordinary Differential Equations, Printice Hill

4. W E Boyce and R C Diprima, Elementary Differential Eqautions and Boundary Value Problems, 9th edition, Wiley

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
c)	Assignment	12
d)	Seminar/ Viva Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU5DSCMAT301: REAL ANALYSIS I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC	300-399	KU5DSCMAT301	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course provides a rigorous foundation in real analysis, focusing on the theoretical underpinnings of calculus and the structure of the real number system. Topics include properties of real numbers, sequences and series of real numbers. Emphasis is placed on developing precise mathematical reasoning and proof-writing skills. The course is essential for students intending to pursue advanced studies in mathematics or related fields.

Course Prerequisite

Set theory, Functions.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand finite and infinite sets, Countable and Uncountable sets, Cantor's theorem.	Understand
2	Understand Algebraic Properties, Order Properties and Absolute values of $\mathbb{R}$. Understand the Completeness Property of $\mathbb{R}$ and its applications to derive Archimedean Property and Density theorem.	Apply
3	Understand Sequences and their Limits, Limit Theorems	Understand
4	Understand Subsequences and the Bolzano-Weierstrass Theorem, The Cauchy Criterion.	Understand
5	Understand Infinite Series, Absolute Convergence and nonabsolute Convergence	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓					
CO 2	✓	✓					
CO 3	✓	✓					
CO 4	✓	✓					
CO 5	✓	✓					

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Finite and Infinite Sets**		12
	1	a) Finite and Infinite Sets b) Countable sets c) Uncountable sets d) Cantor's theorem	
II	**The Real Numbers**		13
	1	a) Algebraic and Order Properties of $\mathbb{R}$ b) Absolute Value and Real Line c) The Completeness Property of $\mathbb{R}$ d) Applications of the Supremum Property	
III	**Sequences**		18
	1	a) Sequences and their Limits b) Limit Theorems c) Monotone Sequences d) Subsequences and the Bolzano-Weierstrass Theorem e) The Cauchy Criterion	

<table>
<tr><td rowspan="4">IV</td><td colspan="2">Series</td><td rowspan="4">12</td></tr>
<tr><td rowspan="3">1</td><td>g) Introduction to Infinite Series</td></tr>
<tr><td>h) Absolute Convergence, Tests for Absolute Convergence</td></tr>
<tr><td>i) Tests for Non-absolute Convergence</td></tr>
<tr><td rowspan="5">V</td><td colspan="2">Teacher Specific Module</td><td rowspan="5">5</td></tr>
<tr><td colspan="2">Directions</td></tr>
<tr><td colspan="2">Logic and proofs</td></tr>
<tr><td colspan="2">Finite and countable sets</td></tr>
<tr><td colspan="2">Properly divergent sequences</td></tr>
</table>

Essential Readings

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis (4th edition), Wiley

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 1.3	
II	1	1	Section 2.1, 2.2, 2.3, 2.4	
III	1	1	Sections 3.1, 3.2, 3.3, 3.4, 3.5	
IV	1	1	Sections 3.7, 9.1, 9.2, 9.3	

Suggested Readings

1. T.M. Apostol, Mathematical Analysis (2nd edition), Addison-Wesley
2. W. Rudin, Principles of Mathematical Analysis (3rd edition), McGraw-Hill
3. H.L. Royden, Real Analysis (3rd edition), PHI
4. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Company
5. D. Chatterjee, Real Analysis, PHI.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU5DSCMAT302
BASIC ABSTRACT ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC	300-399	KU5DSCMAT302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces the abstract structures like group, rings, integral domains and fields and to discuss basic properties and problems in groups.

Course Prerequisite

Set and Functions.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend binary operations and groups.	Understand
2	Classify abelian groups and non-abelian groups.	Understand
3	Understand permutation groups.	Understand
4	Determining the subgroups of groups, cyclic subgroups and cyclic groups.	Apply
5	Comprehend generating sets, group of permutations and cosets	Understand
6	Understand Factor groups, Rings, Fields and integral domain	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✔						
CO 2	✔						
CO 3	✔		✔				

CO 4	✔						
CO 5	✔	✔					
CO 6	✔						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Groups**	14
	1	**Binary operations**	
		a) Definitions and Examples	
		b) Tables	
	2	**Groups**	
		a) Definition and Examples	
		b) Elementary Properties of Groups	
		c) Group Isomorphisms	
		d) Properties of Group Tables	
	3	**Abelian Examples**	
II		**Subgroups and Cyclic groups**	14
	1	**Nonabelian Examples**	
		a) Notation and Terminology	
		b) Permutations	
		c) Disjoint Cycles	
		d) The Dihedral Group	
	2	**Subgroups**	
		a) Subsets and Subgroups	
		b) Cyclic Subgroups	

	3	**Cyclic Groups**	
		a) Elementary Properties of Cyclic Groups	
		b) The structure of Cyclic Groups	
		c) Subgroups of Finite Cyclic Groups	
III	**Generating Sets and Structure of Groups**		**13**
	1	**Generating Sets**	
	2	**Groups of Permutations**	
		a) Group homomorphism	
		b) Cayley's Theorem	
		c) Even and Odd Permutations	
		d)The Alternating Groups	
	3	**Cosets and the Theorem of Lagrange**	
		a) Cosets	
		b) The Theorem of Lagrange	
		c) Cosets Left and Right	
IV	**Factor Groups, Rings and Fields**		**14**
	1	**Factor Groups**	
	2	**Rings and Fields**	
		a) Definitions and Basic Properties	
		b) Homomorphisms and Isomorphisms	
		c) Multiplicative Questions: Fields	
	3	**Integral Domains**	
		a) Divisors of Zero and Cancellation	
		b) Integral Domains	
		c)The Characteristic of a Ring	
V	**Teacher Specific Module**		**5**
	Directions		
	Omitted Proofs of the above sections.		
	Cayley Digraphs		
	Plane Isometries		

Essential Readings

1. John B. Fraleigh, A First Course in Abstract Algebra, Eighth Edition, Pearson.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	1.1 to 1.30	
	2		2.1 to 2.23	
	3		3.1 to 3.5	
II	1		4.1 to 4.21	Omitting the proofs of 4.17 and 4.21
	2		5.1 to 5.26	
	3		6.1 to 6.21	Omitting the proofs of 6.2,6.10 and 6.15
III	1		7.1 to 7.6	
	2		8.1 to 8.25	Omitting the proofs of 8.5 and 8.19
	3		10.1 to 10.20	Omitting the proof of 10.17
IV	1		12.1 to 12.11	
	2		22.1 to 22.18	
	3		23.1 to 23.14	

Suggested Readings

1. J.A Gallian, Contemporary Abstract Algebra, Narosa.
2. I.N Herstein, Topics in Algebra (2nd edition), Wiley
3. M. Artin, Algebra, Prentice Hall

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper*	12
b)	Assignment	12
c)	Seminar/ Viva-voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU5DSCMAT303
MATRICES, FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC	300-399	KU5DSCMAT303	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces fundamental concepts in matrices, Fourier series, and partial differential equations, with applications. Topics include matrix operations, eigenvalues and eigenvectors, Fourier series representations of periodic functions, and methods for solving first- and second-order partial differential equations such as the heat and wave equations. The course emphasizes both theoretical understanding and practical problem-solving skills.

Course Prerequisite

Basic knowledge of differentiation and integration, matrices and ordinary differential equations.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend basic matrix operations and rank of a matrix	Understand
2	Apply Gauss-Jordan elimination, matrix inversion and Cayley-Hamilton theorem to solve systems of linear equations efficiently	Understand
3	Comprehend eigenvalues and eigenvectors of matrices	Understand
4	Understand and construct Fourier series for periodic functions, including arbitrary periods and half-range expansions	Understand
5	Understand and solve basic PDEs by separating variables and Fourier series, including specific solutions for the wave and heat equations.	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Matrices I**		14
	1	**Basic Operations**	
		(a) Quick review of Matrix Addition, Subtractions, Scalar Multiplication, Matrix Multiplication and Transpose of a Matrix.	
		(b) Row-Echelon form	
		(c) Elementary Row and Column Operations	
		(d) Rank of a Matrix	
	2	**Simultaneous Linear Equations**	
		(a) Consistency, Matrix notation	
		(b) Theory of solutions, Simplifying operations, Gaussian elimination algorithm, Pivoting strategies	
		(c) Gauss-Jordan elimination.	

II	**Matrices II**		14
	1	**Matrix inversion**	
		(a) The Inverse	
		(b) Simple inverses	
		(c) Calculating inverses (Using elementary raw operations)	
		(d) Simultaneous linear equations	
		(e) Properties of the inverse	
	2	**Eigenvalues and Eigenvectors**	
		(a) Characteristic equation, characteristic polynomial, eigenvalues, eigenvectors	
		(b) Properties of eigenvalue and eigenvectors	
		(c) Cayley-Hamilton theorem	
III	**Fourier Series**		**13**
	1	(a) Fourier Series	
		(b) Functions of Any Period *p=2L*	
		(c) Even and Odd Functions. Half-Range Expansions	
IV	**Partial Differential Equations**		**14**
	1	a) Basic Concepts of PDEs	
		b) Solution by Separating Variables. Use of Fourier Series	
		c) D'Alembert's Solution of the Wave Equation.	
		d) Heat Equation: Solution by Fourier Series (exclude other problems)	
V	**Teacher specific module**		**5**
	1	Proofs of properties of eigenvalues and eigenvectors	
	2	Vectors, linearly independent vectors, raw rank, column rank	

Essential Readings

1. Bronson, R., *Theory and Problems of Matrix Operations* (2nd ed.), Schaum's Outline Series, McGraw-Hill.
2. Erwin Kreyszig, Advanced Engineering Mathematics (10th edition).

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Chapter 1	*Quick review of matrix addition, subtraction, scalar multiplication, matrix multiplication, and transpose of a matrix. Questions from these topics should not be asked in the End Semester Examination.*
	2	1	Chapter 2	*Proofs of all theorems are excluded. Pivoting strategies and Gauss-Jordan elimination are also excluded*
II	1	1	Chapter 4	*4.13 and 4.14 are excluded*
	2	1	Chapter 7	*All problems related to linearly independent vectors, left and right eigenvalues, the proof of the Cayley-Hamilton theorem, and the proofs of properties of eigenvalues and eigenvectors are excluded.*
III	1	2	Sections 11.1,11.2, 11.3	
IV	1	2	Section 12.1, 12.3, 12.4, 12.6	

Suggested Readings

1. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). Linear Algebra and Its Applications (6th ed.). Pearson Education.
2. Narayan, S., & Mittal, P. K. (2004). Textbook of Matrices. S. Chand & Company Ltd.
3. Ayres, F. Jr. (1966). Theory and Problems of Matrices (Schaum's Outline Series). McGraw-Hill.
4. Higher Engineering Mathematics, B.S. Grewal (43rd edition), Khanna Publishers
5. S.L. Ross, Differential Equations, 3rd Edition, Wiley.
6. G. Birkhoff and G.C. Rota, Ordinary Differential Equations, Wiley and Sons, 3rd Edition
7. E.A. Coddington, An Introduction to Ordinary Differential Equtions, Printice Hall

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. The average mark of the best two tests is to be considered for the internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU6DSCMAT301: VECTOR CALCULUS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC	300-399	KU6DSCMAT301	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course in Vector Calculus provides students with a comprehensive understanding of parametric curves, vector valued functions, differentiation and integration techniques, surface area, surface integrals, and applications of Green's theorem, Stoke's theorem, Divergence theorem and solving physical problems and preparing for advanced studies.

Course Prerequisite

Differentiation, Integration, Vectors.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand curves in space, their tangents, normal and arc length in space.	Apply
2	Understand Directional derivatives and gradient vectors, tangent planes and differentials.	Understand
3	Understand Line integrals. Solve for work, circulation and flux using line integrals.	Understand
4	Understand path independence conservative fields and potential functions.	Apply
5	Understand Green's theorem and solve problems using Green's theorem	Apply
6	Understand Surface area and surface integrals	Understand
7	Understand Stoke's theorem, Divergence theorem and solve problems using Stoke's Theorem and Divergence theorem	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓		✓			
CO 2	✓	✓					
CO 3	✓	✓					
CO 4	✓	✓					
CO 5	✓	✓		✓			
CO 6	✓	✓		✓			
CO 7	✓	✓		✓			

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**GEOMETRY OF SPACE AND MOTION IN SPACE**	14
	1	(a) Curves in space and their tangents	
		(b) Arc length in space	
		(c) Curvature and normal vector of a curve	
II		**PARTIAL DERIVATIVES**	13
	1	a) Directional derivatives and gradient vectors	
		b) Tangent planes and differentials	
III		**INTEGRATION IN VECTOR FIELDS I**	14
	1	a) Line integrals	
		b) Vector fields and line integrals: work, circulation and flux	
		c) Path independence, conservative fields and potential functions	
		d) Green's theorem in the plane	

IV	**INTEGRATION IN VECTOR FIELDS II**			**14**
	1	a) Surfaces and area		
		b) surface integrals		
		c) Stokes' theorem (theorem without proof) (paddle wheel interpretation of $\nabla\times F$ is excluded)		
		d) The Divergence Theorem (theorem without proof) (Gauss' law: one of the four great laws of Electromagnetic Theory, continuity equation of hydrodynamics, unifying the integral theorems are excluded)		
V	**Teacher Specific Module**			**5**
	Directions			
	a) Extreme values and saddle points			
	b) Lagrange multipliers			
	c) Partial derivatives with constrained variables			

Essential Readings

1. G.B, Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus (12th edition), Pearson Education.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 13.1, 13.3, 13.4	
II	1	1	Sections 14.5, 14.6	
III	1	1	Sections 16.1, 16.2, 16.3, 16.4	*Proof of Green's Theorem excluded*

IV	1	1	Sections 16.5, 16.6, 16.7, 16.8	*Stokes' theorem (paddle wheel interpretation of $\nabla\times F$ is excluded)* *The Divergence Theorem without proof* *(Gauss' law: one of the four great laws of Electromagnetic Theory, continuity equation of hydrodynamics, unifying the integral theorems are excluded*)

Suggested Readings

1. E. Kreyzig, Advanced Engineering Mathematics (10^{th} Edition), Wiley
2. H. F. Davis and A. D. Snider, Introduction to Vector Analysis (6^{th} Edition), Universal Book Stall, New Delhi.
3. F. W. Bedford and T. D. Dwivedi, Vector Calculus, McGraw Hill BookCompany
4. S.S. Sastry, Engineering Mathematics, Vol 2 (4^{th} edition), PHI
5. B.S. Grewal, Higher Engineering Mathematics (43^{rd} edition), Khanna Publishers.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU6DSCMAT302: REAL ANALYSIS II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC	300-399	KU6DSCMAT302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course provides a rigorous foundation in Real Analysis, focusing on the fundamental structures and functions within the real number system. Topics include the theory of intervals, properties of continuous and uniformly continuous functions, and the Riemann integral. The course also explores special functions, specifically the Beta and Gamma functions, highlighting their analytical properties and applications. Designed for students pursuing advanced mathematics, this course emphasizes precise reasoning, proof techniques, and the theoretical underpinnings of calculus.

Course Prerequisite

Familiarity with the real number system including supremum and infimum.

Basic limit theory.

Understanding of sequences of real numbers.

Experience with writing mathematical proofs (e.g., direct, contrapositive, contradiction, induction).

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the characterization of intervals	Understand
2	Understand Continuous Functions, composition of continuous functions and continuous functions on intervals.	Understand
3	Understand Uniform Continuity, Monotone and Inverse Functions	Understand

4	Understand Riemann Integral and Riemann-integrable Functions	Understand
5	Understand Fundamental Theorem of Calculus	Understand
6	Understand Improper Integrals	Understand
7	Understand Beta and Gamma Functions and their properties.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Continuous Functions**	14
	1	a) Intervals b) Continuous Functions c) Combination of Continuous Functions d) Continuous Functions on Intervals	

II	**Uniform continuity and Monotone functions**		**13**
	1	a) Uniform Continuity b) Monotone and Inverse Functions	
III	**Riemann Integral**		**14**
	1	a) Riemann Integral b) Riemann Integrable functions c) The Fundamental Theorem of Calculus	
IV	**Improper Integrals and Beta and Gamma Functions**		**14**
	1	**Improper Integrals**	
	2	**Beta and Gamma Functions** (a) Beta and Gamma Functions – Definitions (b) Properties of Beta and Gamma Functions (c) Transformations of Gamma Function (d) Some Important Deductions (e) Duplication formula	
V	**Teacher Specific Module**		**5**
	Directions		
	Sequences of functions		
	Series of functions		

Essential Readings

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis (4th edition), Wiley
2. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus (12th edition), Pearson Education
3. S. Narayan and P.K. Mittal, Integral Calculus (11th edition), S. Chand Publishers.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 2.5, 5.1, 5.2, 5.3	

II	1	1	Sections 5.4, 5.6	
III	1	1	Sections 7.1,7.2, 7.3	Proof of Additivity theorem, Lebesgue’s Integrability Criterion and proof of Composition theorem are excluded
IV	1	2	Section 8.7	
	2	3	Sections 7.1, 7.2, 7.3, 7.4, 7.5	

Suggested Readings

6. T.M. Apostol, Mathematical Analysis (2^{nd} edition), Addison-Wesley
7. W. Rudin, Principles of Mathematical Analysis (3^{rd} edition), McGraw-Hill
8. H.L. Royden, Real Analysis (3^{rd} edition), PHI
9. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Company
10. D. Chatterjee, Real Analysis, PHI.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU6DSCMAT303: COMPLEX ANALYSIS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC	300-399	KU6DSCMAT303	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce the notion of Complex functions, Analytic functions, Complex integrals and to discuss the various method for evaluating complex integrals.

Course Prerequisite

Real calculus and line integrals.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehends Analytic Function, Cauchy–Riemann Equations. Laplace’s Equation.	Understand
2	Understand Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithmic functions and General Power of complex numbers	Understand
3	Evaluate line integral in the complex plane, Cauchy’s integral theorem, Cauchy’s integral formula and derivatives of analytic functions	Understand
4	Understand convergence of Sequences and Series of complex functions	Understand
5	Understand power series, functions given by power series, Taylor series, Maclaurin’s Series and Laurent Series	Understand

6	Understand singularities and zeros of complex functions	Understand
7	Understand residue integration method and integrate real integrals	Apply

Mapping of Course Outcomes to POs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓			✓	✓
CO 2	✓		✓			✓	✓
CO 3	✓		✓			✓	✓
CO 4	✓		✓			✓	✓
CO 5	✓		✓			✓	✓
CO 6	✓		✓			✓	✓
CO 7	✓		✓			✓	✓

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Complex Functions and Analyticity**	**14**
	1	Derivative. Analytic Function	
	2	Cauchy–Riemann Equations, Laplace’s Equation	
	3	Exponential Function	
	4	Trigonometric and Hyperbolic Functions. Euler’s Formula	
	5	Logarithm. General Power. Principal Value	

II	**Complex Integration**		**14**
	1	Line Integral in the Complex Plane	
	2	Cauchy’s Integral Theorem	
	3	Cauchy’s Integral Formula	
	4	Derivatives of Analytic Functions	
III	**Power Series, Taylor Series**		**14**
	1	Sequences, Series, Convergence Tests	
	2	Power Series	
	3	Functions Given by Power Series	
	4	Taylor and Maclaurin Series	
IV	**Laurent Series, Residue Integration**		
	1	Laurent Series	**13**
	2	Singularities and Zeros. Infinity	
	3	Residue Integration Method	
V	**Teacher Specific Module**		**5**
	Directions		
	Complex Numbers and Their Geometric Representation, Polar Form of Complex Numbers. Powers and Roots (Essential reading book sections :13.1, 13.2)		2
	Uniform Convergence (Essential reading book Sections :15.5)		1
	Residue Integration of Real Integrals (Essential reading book section:16.4)		2

Essential Readings

1. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley.

Reference Distribution

Module	Unit	Reference No	Sections	Remarks
I	1	1	13.3	
	2	1	13.4	
	3	1	13.5	
	4	1	13.6	
	5	1	13.7	
II	1	1	14.1	
	2	1	14.2	
	3	1	14.3	
	4	1	14.4	
III	1	1	15.1	
	2	1	15.2	
	3	1	15.3	
	4	1	15.4	
IV	1	1	16.1	
	2	1	16.2	
	3	1	16.3	

Suggested Readings

1. J.W. Brown and R.V. Churchil, Complex Variables and Applications (7th edition), McGraw-Hill
2. S.S. Sastry, Engineering Mathematics, Vol 2 (4th edition), PHI
3. W. Rudin, Real and Complex Analysis (3rd edition), Tata McGraw-Hill
4. L.V. Ahlfors, Complex Analysis (3rd edition), McGraw-Hill
5. J.B. Conway, Functions of One Complex Varible (2nd edition), Springer
6. S. Ponnusamy, Foundations of Complex Analysis (2nd edition), Narosa.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU7DSCMAT401: ADVANCED ABSTRACT ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC	400-499	KU7DSCMAT401	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course builds on foundational concepts in abstract algebra and explores more advanced structures and theories. Topics typically include an in-depth study of group theory including Sylow theorems, ring theory including ideal structure, polynomial rings, factorization. The course emphasizes rigorous proof-based learning and develops a deep understanding of algebraic structures and their interconnections

Course Prerequisite

Group Theory, Basic idea of Ring, Integral Domain and Field.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Use the concepts of Finitely Generated Abelian Groups, Homomorphisms and Normal subgroups and Inner Automorphisms to solve different problems.	Apply
2	Comprehend the field of Quotients of an integral domain	Understand
3	Apply the concept of Factor- group computations and Simple Groups to solve problems	Apply
4	Understand the concept of Group action on a set, Isomorphism theorems, Sylow theorems, Homomorphisms and Factor Rings.	Understand
5	Apply the concept of prime and maximal Ideals to do problems.	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✔	✔	✔				
CO 2	✔	✔					
CO 3	✔	✔	✔				
CO 4	✔	✔					
CO 5	✔	✔	✔				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I			14
	1	**Finitely Generated Abelian Groups**	
		a) Direct Products	
		b) The structure of Finitely Generated Abelian Groups	
	2	**Factor Groups**	
		a) Homomorphisms and Factor Groups	
		b) Normal Subgroups and Inner Automorphisms	
	3	**The field of Quotients of an Integral Domain**	
II	1	**Factor Group Computations and Simple Groups**	14
		a) Factor-Group Computations	
		b) Simple Groups	
		c)The Center and Commutator Subgroups	
	2	**Group Action on a Set**	
		a) The Notion of a Group Action b) Isotropy Subgroups	
		c) Orbits	
		d) Applications of G-Sets to Finite Groups	
III	1	**Isomorphism Theorems**	12
	2	**Sylow Theorems**	
		a) The Sylow Theorems	

		b) Applications of the Sylow Theorems	
IV	1.	**Homomorphisms and Factor Rings**	15
		a) Factor Rings	
		b) Homomorphisms	
	2	**Prime and Maximal Ideals**	
		a) Maximal and Prime Ideals	
		b) Prime Fields	
		c) Ideal Structure in F[x]	
		d) Application to Unique Factorization in F[x]	
V	**Teacher Specific Module**		
	Directions		5
	Applications of G-Sets to Counting		
	Rings of Polynomials		
	Factorization of Polynomials over a Field		

Essential Readings

1. John B. Fraleigh, A First Course in Abstract Algebra, Eighth Edition, Pearson.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	9.1 to 9.20	
	2		12.12 to 12.19	
	3		26.1 to 26.10	
II	1		13.1 to 13.23	
	2		14.1 to 14.26	
III	1		16.1 to 16.10	
	2		17.1 to 17.18	
IV	1		30.1 to 30.20	
	2		31.1 to 31.27	

Suggested Readings

1. J.A Gallian, Contemporary Abstract Algebra, Narosa.
2. I.N Herstein, Topics in Algebra (2^{nd} edition),Wiley
3. M. Artin, Algebra, Prentice Hall

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU7DSCMAT402: MATHEMATICAL ANALYSIS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC	400-499	KU7DSCMAT402	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description:

This course includes basics of mathematical analysis - topology of real line, continuity, differentiation and Riemann integration.

Course Prerequisite

Basics of functions, sequence and series.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the basic facts and concepts of real analysis, including properties of the real number system, limits and continuity of functions, differentiability and Riemann integral.	Understand
2	Construct correct mathematical proofs that make use of the properties of the real number system and other basic facts and concepts listed above	Understand
3	Solve problems using fundamental concepts of real analysis	Understand
4	Give detailed examples of how the rigorous mathematical structure of Real Analysis underlies Calculus	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2		✓					✓
CO 3			✓	✓			
CO 4			✓	✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Basic Topology**	14
	1	Finite, Countable and Uncountable Sets	
	2	Metric spaces	
	3	Compact Sets	
	4	Connected Sets	
II		**Continuity**	14
	1	Limits of functions	
	2	Continuous functions	
	3	Continuity and compactness	
	4	Continuity and connectedness	
	5	Discontinuities	
III		**Differentiation**	13
	1	Derivative of a real function	
	2	Mean value theorems	
	3	Continuity of derivatives	
	4	L' Hospital's rule	
	5	Derivatives of higher order	
	6	Taylor's theorem	
IV		**Riemann - Stieltjes integral**	14
	1	Definition and existence of the integral	
	2	Integration and differentiation	
	3	Integration of vector - valued functions	
	4	Rectifiable curves	
V		**Teacher Specific Module**	5
		Directions	
		Perfect Sets	
		Monotonic functions	
		Infinite limits and Limits at infinity	

Essential Readings

1. Walter Rudin, Principles of Mathematical Analysis (Third Edition), McGraw Hill, 1976.

Reference Distribution

Module	Unit	Reference No.	Sections / Page Nos.	Remarks
1	2	1	Sections 2.1 - 2.42 Sections 2.45 - 2.47	
2	4	1	Sections 4.1 – 4.27	
3	5	1	Sections 5.1 – 5.15	
4	6	1	Sections 6.1 – 6.27	
5	2	1	Sections 2.43 - 2.44	
	4	1	Sections 4.28 – 4.34	
	5	1	Sections 5.16 – 5.19	

Suggested Readings

1. T. M. Apostol, Mathematical Analysis (Second Edition), Narosa, 2002.
2. R. G. Bartle, The Elements of Real Analysis (Second Edition), Wiley International, 1975.
3. G. F. Simmons, lntroduction to Topology and Modern Analysis, McGraw Hill, 2017.
4. Charles Chapman Pugh, Real Mathematical Analysis, Springer, 2010.
5. Sudhir R. Ghorpade and Balmohan V. Limaye, A Course in Calculus and Real Analysis, Springer, 2005.
6. R. G. Bartle and D. R Sherbert, Introduction to Real Analysis, lohn Wiley Bros., 1982.
7. L. M Graves, The Theory of Functions of a Real Variable, Tata McGraw- Hill, 1978.
8. M. H Protter and C.B Moray, A First course in Real Analysis, Springer, 1977.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar/	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU7DSCMAT403: BASIC TOPOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC	400-499	KU7DSCMAT403	4	100

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4			30	70	100	2

Course Description

This course provides important concepts in metric space and point set topology. We begin the course by metric spaces. Then we introduce the concept of topological spaces and its properties.

Course Prerequisite

Set theory, Well-ordered sets.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Demonstrate an understanding of the concepts of metric space	U
2	Realise the structure of topological spaces using continuous functions and homeomorphisms	A
3	Realise different topology such as product topology and metric topology	U
4	Develop the concepts of topological property	An
5	Develop the concepts of metrizable space	An

***Remember (R), Understand (U), Apply (A), Analyse (An)**

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**METRIC SPACES**	13
	1	Metric and Metric Spaces	
		a) The Definition and Some Examples	
	2	Open Sets	
	3	Closed Sets	
	4	Convergence and Completeness (Exclude Baire's Theorem)	
II		**TOPOLOGICAL SPACES**	14
	1	Topological Spaces	
	2	Basis for a Topology	
	3	The Order Topology	
	4	The Product Topology on $X \times Y$	
III		**THE SUBSPACE TOPOLOGY**	14
	1	The Subspace Topology	
	2	Closed sets and Limit points	
	3	Continuous Functions	

IV	**THE PRODUCT TOPOLOGY**		**14**
	1	The Product Topology	
	2	The Metric Topology	
	3	The Metric Topology (continued)	
V	**Teacher Specific Module**		**5**
	Directions		
	The Quotient Topology		

Essential Readings

1. G.F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill,
2. J.R. Munkres, Topology – A First Course, Pearson India (Second Edition), 2014.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Chapter 2 Section 9	
	2	1	Section 10	
	3	1	Section 11	
	4	1	Section 12	
II	1	2	Chapter 2 Section 12	
	2	2	Section 13	
	3	2	Section 14	
	4	2	Section 15	
III	1	2	Section 16	--
	2	2	Section 17	--
	3	2	Section 18	--
IV	1	2	Section 19	--
	2	2	Section 20	--
	3	2	Section 21	--

Suggested Readings

1. C. Wayne Patty, Foundations of Topology, Joes and Bartlet, 2010
2. K. Parthasarathy, Topology - An Invitation, Springer 2022
3. K.D Joshy, Introduction to General Topology, New age International, 1983.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU7DSCMAT404: LINEAR ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC	400-499	KU7DSCMAT404	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to introduce the notation of vector space, Basis, Linear Transformation, Matrix representation of Linear Transformations.

Course Prerequisite

Fields, operations of matrices.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Generalization of concrete notion of vectors (as directed line segment) to an abstract notion of vector space.	Understand
2	Understand the notion of linear dependence and linear independence.	Understand
3	Understand the notion of basis.	Understand
4	Understanding the matrix representation of linear transformation in facilitating computation and application.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✔						
CO 2	✔						
CO 3	✔						
CO 4	✔						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
1	**MODULE I**		**13**
	1	**Vector Spaces**	
	2	**Subspaces**	
2	**MODULE II**		**14**
	1	**Linear Combinations and Systems of Linear Equations**	
	2	**Linear Dependence and Linear Independence**	
3	**MODULE III**		**14**
	1	**Bases and Dimension**	
4	**MODULE IV**		**14**
	1	**Linear Transformations, Null Spaces and Ranges (Proof of Theorem 2.3 excluded)**	
	2	**The Matrix Representation of a Linear Transformation (Operations of Linear Transformations and related theorems are excluded).**	
5	**Teacher Specific Module**		**5**
	Directions		
	1. System of linear equations *2. Eigen vectors and eigen values* *3. Cayley Hamilton theorem*		

Essential Readings

1. Linear Algebra, Stephen H. Friedberg, Arnoled J. Insel and Lawrence E. Spence (4th edition)

Reference Distribution

Module	Unit	Reference No.	Sections/Page Nos.	Remarks
1	1	1	1.2	
	2	1	1.3	
2	1	1	1.4	
	2	1	1.5	
3	1	1	1.6	
4	1	1	2.1	Proof of Theorem 2.3 excluded
	2	1	2.2	Operations of Linear Transformations and related theorems are excluded

Suggested Readings

1. Linear Algebra and its Applications, David. C. Lay, Steven. R. Lay, Judy. J. McDonald (5th edition).
2. Linear Algebra Done Right, Sheldon Axler, Springer (4th edition)

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU7DSCMAT405
ADVANCED ORDINARY DIFFERENTIAL EQUATIONS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC	400	KU7DSCMAT405	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4			30	70	100	2

Course Description

Advanced Ordinary Differential Equations is a rigorous course that explores the theory and methods for analyzing and solving ordinary differential equations beyond the introductory level. The course covers second order ODE and special functions.

Course Prerequisite

Basic differential equations.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand ordinary points	Understand
2	Understand regular singular points	Understand
3	Comprehend Legendre polynomials	Understand
4	Understand Bessel functions	Understand
5	Comprehend Gamma functions	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓	✓				✓
CO 2	✓		✓	✓		✓	
CO 3	✓		✓				✓
CO 4	✓	✓	✓	✓		✓	
CO 5	✓		✓		✓	✓	
CO 6	✓	✓	✓	✓			✓
CO 7	✓	✓	✓			✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Power Series Solutions and Special Functions-1**		14
	1	Second Order Linear Equations. Ordinary Points	
	2	Regular Singular Points	
II	**Power Series Solutions and Special Functions-2**		14
	1	Regular Singular Points (Continued)	
	2	Gauss's Hypergeometric Equation	
III	**Some Special Functions of Mathematical Physics 1**		13
	1	Legendre Polynomials chapter	
	2	Properties of Legendre Polynomials	
IV	**Some Special Functions of Mathematical Physics2**		14
	1	Bessel Functions. The Gamma Function	
	2	Properties of Bessel Functions	
V	**TEACHER SPECIFIC MODULE**		5
	1	Introduction. A Review of Power Series	
	2	Series Solutions of First Order Equations	

Essential Readings

1. G.F Simmons; Differential Equations with Historical Notes [Third Edition]; CRC Press-Taylor and Francis Group; 2017.

Reference Distribution

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Chapter 5: Section 28	
	2	1	Chapter 5: Section 29	
II	1	1	Chapter 5: Section 30	
	2	1	Chapter 5: Section 31	

III	1	1	Chapter 8: Section 44	
	2	1	Chapter 8: Section 45	
IV	1	1	Chapter 8: Section 46	
	2	1	Chapter 8: Section 47	

Suggested Readings

1. G. Birkoff and G. C Rota;Ordinory Differential Equations; Fourth Edition; Wiley and Sons; 1978.
2. E. A Coddington; An Introduction to Ordinary Differential Equations; Prentice Halt of India; 1974.
3. P. Hartmon; Ordinary Differential Equations; Society for Industrial and applied; 1987
4. Chakraborti; Elements of Ordinary Differential Equations and Special Functions; WileyEastern, 1990
2. L.S Poutrigardian; A Course in Ordinary Differential Equations; Hindustan Publishing Corp.; 1967
3. S.G Deo and V.Raghavendra; Ordinary Differential Equations and Stability Theory; Tata McGraw Hill; 1967
4. V. I. Arnold; Ordinary Differential Equations; MIT Press Cambridge; 1981

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		70
Continuous Evaluation		30
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU8DSCMAT401: ADVANCED TOPOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSC	400-499	KU8DSCMAT401	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4			30	70	100	2

Course Description

This course provides the concept of connectedness, compactness and related concepts. We begin the course by connectedness and then we introduce the compactness. Also we introduce countability axioms and separability axioms.

Course Prerequisite

Basic knowledge of Topological Spaces.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Develop the concepts of connectedness and related properties	An
2	Develop the concepts of compactness and related properties	An
3	Understand the Countability Axioms	U
4	Understand the Separation Axioms	U
5	Understand the Classical Theorems in Topology - Urysohn Lemma, Urysohn Metrization theorem, Tietze Extension	U

****Remember (R), Understand (U), Apply (A), Analyse (An)***

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
1	**CONNECTED SPACES**		**13**
	1	Connected Spaces	
	2	Connected subspaces of the Real Line	
	3	Components and Local Connectedness	
2	**COMPACT SPACES**		**14**
	1	Compact Spaces	
	2	Compact Subspaces of the Real Line	
	3	Limit Point Compactness	
	4	Local Compactness	
3	**COUNTABILITY AND SEPARATION AXIOMS**		**14**
	1	The Countability Axioms	
	2	The Separation Axioms	
	3	Normal Spaces	
4	**NORMAL SPACES**		**14**

	1	The Urysohn Lemma	
	2	The Urysohn Metrization Theorem	
	3	The Tietze Extension Theorem	
5	**Teacher Specific Module**		**5**
	Directions		
	The Tychonoff Theorem The Stone-Cech Compactification		

Essential Readings

1. J.R. Munkres, Topology – A First Course, Pearson India (Second Edition), 2014.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
1	1	1	Chapter 3 Section 23	
	2	1	Section 24	
	3	1	Section 25	
2	1	1	Chapter 3 Section 26	
	2	1	Section 27	
	3	1	Section 28	
	4	1	Section 29	
3	1	1	Chapter 4 Section30	--
	2	1	Section 31	--
	3	1	Section32	--
4	1	1	Chapter 4 Section 33	--
	2	1	Section 34	--
	3	1	Section 35	--

Suggested Readings

1. C. Wayne Patty, Foundations of Topology, Joes and Bartlet, 2010
2. K. Parthasarathy, Topology - An Invitation, Springer 2022
3. K.D Joshy, Introduction to General Topology, New age International, 1983

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU8DSCMAT402: ADVANCED LINEAR ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSC	400 - 499	KU8DSCMAT402	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is to understand the basic ideas of Vector spaces, Linear transformations, Decomposition of Linear operators and Inner product spaces.

Course Prerequisite

Basic Algebra and Vector Spaces.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	To understand the basic linear algebra- vector space, linear transformations and inner product spaces	Understand
2	Apply linear algebra techniques to solve a wide range of mathematical problems, especially in matrix theory.	Understand
3	Analyse and manipulate Eigen values and Eigen vectors to solve problems related to Diagonalization	Understand
4	Equip students with a profound comprehension of linear algebra, which will serve as a solid foundation for further studies, particularly in the context of functional analysis course.	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✔						
CO 2	✔						
CO 3	✔						
CO 4	✔						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I			14
	1	**Linear Transformations (Quick Review) and Algebra of Linear Transformations**	
	2	**Isomorphism**	
	3	**Representation of Transformations by Matrices**	
II			13
	1	**Linear Functionals**	
	2	**The Double Dual**	
	3	**The Transpose of a Linear Transformation**	
III			13
	1	**Characteristic Values**	
	2	**Annihilating Polynomials**	
	3	**Invariant Subspaces**	
IV			15
	1	**Jordan Canonical Forms and Applications**	
	2	**Inner Product Spaces**	
V	**Teacher Specific Module**		5
	Directions		
	4. Direct-Sum Decompositions ***5. Primary Decomposition Theorem*** ***6. Cyclic Decompositions***		

Essential Readings

1. Kenneth Hoffman & Ray Kunze; Linear Algebra(Second Edition), Prentice Hall of India Pvt. Ltd
2. D W Lewis, Matrix Theory, World Scientific Publishing Company, 1991.

Reference Distribution

Module	Unit	Reference No.	Sections/Page Nos.	Remarks
I	1	1	3.1, 3.2	
	2	1	3.3	
	3	1	3.4	
II	1	1	3.5	
	2	1	3.6	
	3	1	3.7	
III	1	1	6.1, 6.2	
	2	1	6.3	
	3	1	6.4	
IV	1	2	5.1- 5.3	
	2	1	8.1, 8.2	

Suggested Readings

1. Stephen H Friedberg Arnold J Insel and Lawrence E Spence, Linear Algebra (Fourth Edition), Prentice Hall, 2015.
2. Sheldon Axler, Linear Algebra Done Right (Third Edition), Springer, 2015.
3. Martin Anthony and Michele Hawey, Linear Algebra: Concepts and Methods, Cambridge University Press, 2012.
4. S. Kumaresan, Linear Algebra: A Geometric Approach, PHl Learning Pvt. Ltd., 2000.
5. Serge A Lang, Linear Algebra (Third Edition), Springer, 2004.
6. Paul R Halmos, Finite-Dimensional Vector Spaces, Springer 1974.
7. Michael Artin, Algebra (Second Edition), Addison Wesley, 2010.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU8DSCMAT403: MEASURE THEORY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSC	400-499	KU8DSCMAT403	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4			30	70	100	2

Course Description

This course provides a rigorous introduction to measure theory and the Lebesgue integral, foundational tools in modern analysis. Topics include sigma-algebras, measurable functions, Lebesgue measure and Lebesgue integration. The course emphasizes the development of mathematical maturity and abstract reasoning through theoretical understanding and proof-based learning

Course Prerequisite

Basic topology of the real line, sequence and series of functions, Riemann integral.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts of sigma-algebras, measurable sets, and measures.	Understand
2	Comprehend and utilize the Lebesgue measure on the real line and other spaces.	Understand
3	Compute Lebesgue integrals and understand their properties and advantages over Riemann integrals.	Understand
4	Comprehend L_p spaces	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓			✓			
CO 2	✓	✓			✓		
CO 3	✓		✓				✓
CO 4	✓		✓			✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Measure on the Real Line**	13
	1	Lebesgue Outer measure (Chapter 2: Section 2.1)	
	2	Measurable sets (Chapter 2: Section 2.2)	
	3	Regularity (Chapter 2: Section 2.3)	
	4	Measurable Functions (Chapter 2: Section 2.4)	
II		**Integration of functions of a Real Variable**	14
	1	Integration of Non-negative Functions (Chapter 3: Sections 3.1)	
	2	The general lntegral (Chapter 3: Section 3.2)	
	3	Integration of Series (Chapter 3: Section 3.3)	
	4	Riemann and Lebesgue lntegrals (Chapter 3: Section 3.4)	
III		**Abstract Measure Space**	14
	1	Measures and Outer measures (Chapter 5: Section 5.1)	
	2	Extension of measure (Chapter 5: Section 5.2)	
	3	Uniqueness of the extension (Chapter 5: Section 5.3)	
IV		**Abstract Measure Space, Inequalities and the L_P Spaces**	14
	1	Measure spaces (Chapter 5: Section 5.5)	
	2	Integration with respect to a Measure (Chapter 5: Section 5.6)	
	3	The L_P Spaces (Chapter 6: Section 6.1)	
	4	Jensen's Inequality (Chapter 6: Sections 6.3)	
V		**Teacher Specific Module**	5
		Inequalities and the L_P Spaces: The inequalities of Holder and Minkowski, Completeness of L_P-spaces (Chapter 6: sections 6.4 and 6.5)	
		Space to fill the selected area/ activity	

Essential Readings

1. G De Barra, Measure Theory and Integration. (2nd Edition), New Age International Pw. Ltd., 2003.

Reference Distribution

Module	Unit	Reference No.	section	Remarks
I	1	1	2.1	
	2	1	2.2	
	3	1	2.3	
	4	1	2.4	
II	1	1	3.1	
	2	1	3.2	
	3	1	3.3	
	4	1	3.4	
III	1	1	5.1	--
	2	1	5.2	--
	3	1	5.3	--
IV	1	1	5.5	--
	2	1	5.6	--
	3	1	6.1	
	4	1	6.3	--

Suggested Readings

1. Walter Rudin, Real and Complex Analysis (Third Edition), Tata McGraw H i11,2017
2. H. L Royden, P M Fitzpatrick, Real Analysis, Pearson, Fourth Edition, Pearson, 2015
3. R.G. Bartle, The Elements of integration and Measure Theory, John Wiley and Sons, 1995

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

DISCIPLINE SPECIFIC ELECTIVE COURSES

KU5DSEMAT301: NUMERICAL ANALYSIS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU5DSEMAT301	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course offers a comprehensive introduction to Numerical Analysis, focusing on the development and analysis of algorithms for obtaining approximate solutions to mathematical problems. Topics include error analysis, solutions of nonlinear equations, interpolation and polynomial approximation, numerical differentiation and integration, and the numerical solution of systems of linear equations and ordinary differential equations. Emphasis is placed on both the theoretical understanding of numerical methods and their practical implementation using computational tools. The course is designed to equip students with the skills needed to solve real-world problems where exact analytical solutions are difficult or impossible to obtain.

Course Prerequisite

Derivatives, integrals and the fundamentals of differential equations.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand solution of transcendental equation	Understand
2	Understand bisection and Regula-falsi method	Understand
3	Understand Lagrange interpolation, Finite difference operators and finite differences, Newton's interpolation formulae	Understand
4	Understand Trapezoidal rule and Simpson's rule	Understand
5	Understand Taylor series method, Euler method, Runge-Kutta methods (2nd order). .	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✔						
CO 2	✔						
CO 3	✔						
CO 4	✔						
CO 5	✔						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Solution of Algebraic and Transcendental Equation**	**14**
	1	Introduction to solution of algebraic and transcendental equation	
		a) Initial approximations	
	2	Bisection method,	
	3	Regula-falsi method	
II		**Interpolation**	**15**
	1	Interpolation with unevenly spaced points	
		a) Lagrange interpolation	
	2	Interpolation with uniform spaced points	
		a) Finite difference operators and finite differences (exclude central difference operator, table 4.6 and relations between differences and derivatives)	
		b) Newton's interpolation formulae	
III		**Numerical Integration**	**12**
	1	Trapezoidal rule	
	2	Simpson's rule	
IV		**Numerical Solutions of Ordinary Differential Equations**	**14**
	1	Introduction	
	2	Taylor series method	
	3	Euler method	
	4	Runge Kutta methods (2nd order).	

V	**Teacher Specific Module**	**5**
	Directions	
	7. Central difference 8. Runge Kutta methods (4^{th} order).	

Essential Readings

1. Mathematical Methods, S. R. K. Iyengar, R.K. Jain. Narosa (2^{nd} edition)

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	3.2	
	2	1	3.3	
	3	1	3.4	
II	1	1	4.2	4.2.2 and 4.2.3 excluded
	2	1	4.3	exclude central difference operator, table 4.6 and relations between differences and derivatives
III	1	1	6.3.1	
	2	1	6.3.2	
IV	1	1	7.1	
	2	1	7.3	
	3	1	7.4	
	4	1	7.5	4^{th} order excluded

Suggested Readings

1. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI (5^{th} edition)
2. S. Sankara Rao, Numerical methods of Scientists and Engineers (Third Edn), PHI; 2007
3. F.B. Hildebrand, Introduction Numerical Analysis, Dover publications, 2013.
4. J.B. Scarborough, Numerical Mathematical Analysis, Oxford and IBH, 2005.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	12
c)	Seminar	6
Total		**100**

* A student has to appear for at least two written tests. The average mark of the best two tests is to be considered for the internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU5DSEMAT302: FUZZY MATHEMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU5DSEMAT302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course introduces the principles and applications of Fuzzy Mathematics, a mathematical framework designed to handle uncertainty, vagueness, and imprecision—commonly found in real-world decision-making and control systems. The course covers fundamental topics such as fuzzy sets and their operations, membership functions, fuzzy relations, fuzzy subgroups and fuzzy subrings.

Course Prerequisite

A basic understanding of set theory and logic.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend the concept of Fuzzy Subsets, L-fuzzy Sets and Operations on Fuzzy Subsets	Understand
2	Understand the concept of α- Level Set and the properties of fuzzy subsets of a set	Understand
3	Understand the concepts of algebraic product and sum of two fuzzy subsets and their properties	Understand
4	Understand the concept of Cartesian Product of Fuzzy Subsets	Understand
5	Understand the concepts of fuzzy relations, binary fuzzy relations, and binary relations on a single set	Understand
6	Comprehend the concepts of fuzzy subgroup, fuzzy subgroupoids, lattice of fuzzy subgroups and fuzzy subrings	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓					
CO 2	✓	✓					
CO 3	✓	✓	✓				
CO 4	✓	✓	✓				
CO 5	✓	✓					
CO 6	✓	✓					

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**An Introduction to Fuzzy Subsets**		13
	1	**Introduction**	
		Fuzzy Subsets	
		L-fuzzy Sets	
		Visual Representation of a Fuzzy Subset	
	2	**Operations on Fuzzy Subsets**	14
		Operations on Fuzzy Subsets	
		Empty Fuzzy Subset 0 and Universal Fuzzy Subset	
		Disjoint Fuzzy Subsets	
		Disjunctive Sum	

II	**Operations on fuzzy sets**		
	1	α- Level Set	
	2	Properties of Fuzzy Subsets of a Set	
	3	Algebraic Product and Sum of Two Fuzzy Subsets	
	4	Properties Satisfied by Addition and Product	
	5	Cartesian Product of Fuzzy Subsets	
III	**Fuzzy Relations**		14
	1	Crisp and Fuzzy Relations	
		Binary Fuzzy Relations	
		Binary Relations on a Single Set	
		Fuzzy Equivalence Relations	
IV	**Fuzzy Subgroups and Fuzzy Subrings**		14
	1	Introduction	
		Fuzzy Sub groupoids	
		The Lattice of Fuzzy Subgroups	
		Fuzzy Subgroup	
	2	Fuzzy Sub rings	
V	**Teacher Specific Module**		5
	Directions		
	Fuzzy logic		

Essential Readings

1. Fuzzy Mathematical Concepts, S. Nanda & N.R. Das, Narosa Pub. House
2. Fuzzy Sets and Fuzzy Logic – Theory and Applications, George J. Klir & Bo Yuan, Prentice Hall of India.

Reference Distribution

Module	Reference No.	Sections	Remarks
I	1	Sections 1.1, 1.2, 1.5, 1.6, 1.7, 1.7.1, 1.7.2, 1.8	
II	1	Sections 1.9, 1.10, 1.11, 1.12, 1.13	Proof of theorems in Section 1.13 omitted
III	2	Sections 5.1, 5.3, 5.4, 5.5	
IV	1	Section 3.1, 3.2, 3.2.1, 3.2.2, 3.3.2, 3.5	Theorems 3.5.2, 3.5.3, 3.5.4, 3.5.5 are excluded

Suggested Readings

1. K.H. Lee, First Course on Fuzzy Theory and Applications, Springer- Verlag
2. H.J. Zimmermann, Fuzzy Set Theory-And Its Applications (2nd revised edition), Allied Publishers Limited.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU5DSEMAT303: PROGRAMMING IN PYTHON

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU5DSEMAT303	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	1	35	65	100	1.5

Course Description

This course provides an introduction to programming using the Python language, one of the most popular and versatile programming languages today.

Course Prerequisite

Basic computer literacy.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Apply Core Python Syntax and Semantics	Apply
2	Use Data Types and Variables Effectively	Apply
3	Use conditional statements to control the flow of programs	Apply
4	Develop and use functions and modules	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓				✓		
CO 2	✓				✓		
CO 3	✓				✓		
CO 4	✓				✓		

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Introduction to Python**	11
	1	(a) Features of Python (b) Variables (c) Indentation in Python (d) Input, Output and Import Functions (e) Operators (Sections 1.1, 1.5, 1.7, 1.11, 1.12 of Essential Readings 1) (1.12.4 and 1.12.7 omitted)	
II		**Data types and Operations**	11
	1	(a) Numbers (b) List (c) Tuples (d) Set (e) Dictionaries (Sections 2.1, 2.3, 2.5, 2.6 of Essential Readings 1).	
III		**Flow Control**	11
		(a) Decision making (b) Loops (c) Nested Loops (d) Control Statements (Section 3.1, 3.2, 3.3, 3.4 of Essential Readings 1).	
IV		**Data visualization**	12
		(a) The Matplot lib Module (b) Plotting mathematical functions, Famous Curves (c) 2D plot using colors (d) Mesh grids (e) 3D Plots (Relevant sections from Essential Readings 2).	

<table>
<tr><td rowspan="3">V</td><td>Teacher Specific Module</td><td rowspan="3">30</td></tr>
<tr><td>Directions for Practicals</td></tr>
<tr><td>Programmes
1. Solution of Ax =B using Doolittle method
2. Newton-Raphson’s Method
3. Bisection Method
4. Method of false position
5. Trapezoidal rule of Numerical Integration
6. Simpson’s Three Eighth rule of Numerical Integration
7. Euler’s Modified Method to solve first order differential equation
8. Runge-Kutta Method of Order 4
9. Lagrange’s Method for Interpolation
10.Taylor Series Method for initial value problems.</td></tr>
</table>

Essential Readings

1. Dr. Jeeva Jose, Taming Python by Programming, Khanna Publications
2. B.P. Ajith Kumar, Python for Education – Learning Mathematics and Physics using Python and writing them in Latex (Free download from www.iuac.res.in/phoenix).

Suggested Readings

1. J. Kiusalaas, Numerical methods in Engineering with Python, Cambridge University Press.

Assessment Rubrics

Evaluation Type	Marks
End Semester Evaluation (ESE)	**65 (50 T + 15 P)**
Continuous Evaluation (CCA)	**35 (25 T + 10 P)**
Theory (CCA)	**25**
(a) Test paper	10
(b) Assignment	10
(c) Seminar/Viva-voce	5
Practical (CCA)	**10**
(a) Skill	6
(b) Record	4
Total	**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU6DSEMAT301: GRAPH THEORY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU6DSEMAT301	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course provides an introduction to Graph Theory, a fundamental area of discrete mathematics with wide-ranging applications in computer science, engineering, and network analysis. Topics include graphs and subgraphs, paths and cycles, trees, connectivity, Eulerian and Hamiltonian. Students will learn how to model and analyze problems using graphs and apply graph algorithms to real-world scenarios.

Course Prerequisite

Familiarity with sets, relations, functions and basic proof techniques.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand a graph, subgraph, different types of graphs and their properties	Understand
2	Understand and represent graph as matrix	Understand
3	Understand a path, cycle, tress, bridge and their properties	Understand
4	Understand cut vertices and connectivity of graphs	Understand
5	Understand Eulerian graphs, Hamiltonian graphs. The Chinese Postman Problem and The Travelling Salesman Problem.	Understand
6	Model real world problems using the concept of graphs	Apply
7	Solve real world problems using the concept of graphs	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓		✓				
CO 3	✓		✓				
CO 4	✓		✓				
CO 5	✓			✓		✓	
CO 6	✓			✓		✓	
CO 7	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**An Introduction to Graphs**		13
	1	Definition of Graphs	
		Graph as Models	
		More Definitions	
		Vertex Degrees	
II	**Subgraphs, Paths and Cycles**		14
	1	Sub Graphs	
		Paths and Cycles	
		Matrix Representation	

III	**Trees and Connectivity**		**14**
	1	Definition of Trees and Simple Properties	
		Spanning Trees	
		Bridges	
		Cut vertices and Connectivity	
IV	**Euler Tours and Hamiltonian Cycles**		**14**
	1	Euler Tours	
		The Chinese Postman Problem	
		Hamiltonian Graphs	
		The Travelling Salesman Problem	
V	**Teacher Specific Module**		**5**
	Directions		
	Planarity		

Essential Readings

1. J. Clark and D. A. Dalton, A First Look at Graph Theory, Allied Publishers

Reference Distribution

Module	Reference No.	Sections	Remarks
I	1	Sections 1.1, 1.2, 1.3, 1.4	*Proof of Theorems in 1.4, are omitted*
II	1	Sections 1.5, 1.6, 1.7	Proof of Theorems in Section 1.7 are omitted
III	1	Sections 2.1, 2.2, 2.3, 2.6	Proof of Theorems 2.6, 2.7, 2.9 and 2.13 are omitted. Proof of Theorems 2.20, 2.21 and Corollary 2.22 are omitted.
IV	1	Sections 3.1, 3.2, 3.3, 3.4	Fleury’s Algorithm and Proof of Theorems 3.3, 3.4, 3.5, 3.6, 3.7, 3.8 and Corollary 3.9 are omitted. Algorithm in Section 3.4 is omitted.

Suggested Readings

1. R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory (2nd Edition), Springer.
2. J. A. Bondy and U.S.R. Murthy, Graph Theory with Application, Macmillan.
3. F. Harary, Graph Theory, Narosa.Pub. House
4. K. R. Parthasarathy, Basic Graph Theory, Tata-McGraw Hill.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU6DSEMAT302: OPERATIONS RESEARCH

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSE	300-399	KU6DSEMAT302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course covers the fundamentals of Operations Research including the historical background, mathematical formulation of LPP, graphical solution method, simplex method, transportation Problem, assignment problem and sequencing problems.

Course Prerequisite

Basic understanding of linear algebra, calculus and probability.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand convex sets, convex functions, their properties	Understand
2	Formulate and solve LPP using graphical method and simplex algorithm	Apply
3	LP formulation of transportation problem and its solution	Apply
4	Mathematical formulation of Assignment problem and Hungarian Assignment method	Apply
5	Apply the problem of sequencing in Processing ‘n’ jobs through ‘2’machines, Processing ‘n’ jobs through ‘k’ machines and Processing ‘2’ jobs through ‘k’ machines	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓		✓				
CO 3	✓		✓				
CO 4	✓		✓				
CO 5	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**LINEAR PROGRAMMING PROBLEM**	14
	1	(a) Convex sets and their properties	
		(b) Convex Functions	
		(c) Local and Global Extrema	
		(d) Quadratic forms	
	2	(a) Linear Programming Problem – Mathematical formulation	
		(b) Graphical solution method	
		(c) Some exceptional cases	
		(d) General Linear Programming Problem	
		(e) General Linear Programming Problem , Slack and Surplus Variables, standard form of LPP, Insights into the simplex method	

II		**SIMPLEX METHOD**	**14**
	1	(a) Basic Solution, Degenerate Solution, Basic Feasible Solution, Associated cost vector, Improved basic Feasible solution, Optimum Basic Feasible Solution.	
		(b) Fundamental Properties of solutions, Simplex method – The computational Procedure, The Simplex Algorithm.	
		(c) General Primal-Dual Pair, Formulating a dual problem	
III		**TRANSPORTATION PROBLEM**	**13**
	1	(a) LP formulation of the Transportation Problem	
		(b) Existence of solution in T.P, Duality in Transportation problem	
		(c) The Transportation Table, Loops in Transportation Tables, Triangular basis in a T.P	
		(d) Solution of a Transportation problem, North-west corner Method, Least –Cost Method, VAM	
		(e) Test For Optimality, Degeneracy in TP, MODI Method.	
IV		**ASSIGNMENT PROBLEM AND SEQUENCING PROBLEM**	**14**
	1	(a) Mathematical Formulation of Assignment Problem	
		(b) Hungarian Assignment Method.	
	2	(a) Problem of sequencing, Basic terms used in sequencing	
		(b) Processing ‘n’ jobs through ‘2’ machines	
		(c) Processing ‘n’ jobs through ‘k’ machines	
		(d) Processing ‘2’ jobs through ‘k’ machines	
V		**Teacher Specific Module**	**5**
		Directions	
		Operations research – an overview	
		Dual Simplex method	
		Maintenance Crew Scheduling.	

Essential Readings

1. K. Swarup, P.K.Gupta and M. Mohan, Operations Research (18^{th} edition), Sulthan Chand and Sons.

Reference Distribution

Module	**Unit**	**Reference No.**	**Sections**	**Remarks**
I	1	1	Sections 0:13, 0:15. 0:16, 0:17	*Proof of theorems 0.4, 0.9 & 0.10 omitted*
	2	1	Sections 2:1, 2:2, 2:3, 2:4 and Sections 3:1, 3:2, 3:3, 3:4, 3:5, 3:6	*Canonical form omitted*
II	1	1	Sections 4:1, 4:2, 4:3, 5:1, 5:2, 5:3	*Proof of all theorems omitted*
III	1	1	Sections 10:1,10:2,10:3,10:4,10:5,10:6,10:7, 10:8,10:9,10:10,10:12,10:13	*Proof of theorems omitted*
IV	1	1	Sections 11:1, 11:2, 11:3	
	2	1	Sections 12:1, 12:2, 12:3, 12:4, 12:5, 12.6	
IV	1	1	Sections 17:1, 17:2, 17:3, 17:4, 17:5, 17:6, 17:7	*Proof of theorems omitted*

Suggested Readings

1. J.K. Sharma, Operations Research - Theory and Applications, McMillan
2. H.A. Thaha, Operations Research, An Introduction (8^{th} edition), Prentice Hall
3. G. Hadley, Linear Programming, Oxford & IBH Publishing Company.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	12
c)	Seminar, Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU6DSEMAT303: CRYPTOGRAPHY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSE	300-399	KU6DSEMAT303	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course offers a comprehensive introduction to Cryptography, describes various ciphers, explains its relation with Number Theory. Emphasis is placed on both the theoretical understanding and their practical use.

Course Prerequisite

Basics of number theory

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Simple Cryptosystems namely, The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher and Stream Ciphers	Understand
2	Understand basics of Shannon's Theory, Perfect Secrecy, Entropy, Huffman Encodings and Entropy, Properties of Entropy, Spurious Keys and unicity Distance, Product Cryptosystems.	Understand
3	Understand the Chinese Remainder Theorem	Understand
4	Understand The RSA System and Factoring	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	√			√			
CO 2	√			√			
CO 3	√						
CO 4	√						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Some Simple Cryptosystems**	14
	1	Introduction	
	2	The Shift Cipher	
	3	The Substitution Cipher	
	4	The Affine Cipher	
II		**More Cryptosystems**	14
	1	The Vigenere Cipher	
	2	The Hill Cipher	
	3	The Permutation Cipher	
	4	Stream Ciphers	
III		**Shannon's Theory**	14
	1	Introduction	
	2	Perfect Secrecy	
	3	Entropy, Huffman Encodings and Entropy	
	4	Properties of Entropy	
	5	Spurious Keys and Unicity Distance	
	6	Product Cryptosystems	
IV		**More on Number Theory and RSA System**	13
	1	The Chinese Remainder Theorem	
	2	Other Useful Facts	
	3	Introduction to Public-key Cryptography	
	4	The RSA Cryptosystem, Implementing RSA	
V		**Teacher Specific Module**	5
		Directions	
		9. Legendre and Jacobi Symbols 10. The Solovay-Strassen Algorithm, The 11. Miller Rabin Algorithm	

Essential Readings

1. Douglas R. Stinson, Cryptography: Theory and Practice- Third Edition, CRC Press, 2006.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	1.1	Proof of all theorems are omitted
	2	1	1.1	
	3	1	1.1	
	4	1	1.1	
II	1	1	1.1	
	2	1	1.1	
	3	1	1.1	
	4	1	1.1	
III	1	1	2.1	
	2	1	2.3	
	3	1	2.4	
	4	1	2.5	
	5	1	2.6	
	6	1	2.7	
IV	1	1	5.2.2	Proof of all theorems are omitted
	2	1	5.2.3	
	3	1	5.1	
	4	1	5.3	

Suggested Readings

1. David M. Burton, Elementary Number Theory- Seventh Edition, Mc Graw Hill
2. William Stallings, Cryptography and Network Security Principles and Practices- Fourth Edition, Prentice Hall
3. Christof Paar-Jan Pelzl, Understanding Cryptography- A Text for Students and Practitioners, Springer.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	12
b)	Assignment	12
c)	Seminar	6
Total		**100**

* A student has to appear for at least two written tests. The average mark of the best two tests is to be considered for the internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU8DSEMAT401

RESEARCH METHODOLOGY IN MATHEMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSE	400-499	KU8DSEMAT401	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course is structured to cover theoretical knowledge, practical skills, and research exposure needed to undertake mathematical research effectively

Course Prerequisite

Familiarity with formal proof techniques, Basic Computer Literacy.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand what constitutes research in mathematics and identify ethically sound research problems	Understand
2	Develop solid proof-writing skills and learn how to communicate mathematical ideas formally and effectively	Analyze
3	Learn how to gather, organize, and manage existing research, and use tools to aid mathematical research	Understand
4	Develop independent research and presentation abilities	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓					✓	✓
CO 2	✓	✓	✓				✓
CO 3	✓		✓				✓
CO 4	✓		✓				✓

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Research Methodology – An Introduction**		14
	1	(a) Meaning of Research	
		(b) Objectives of Research	
		(c) Types of Research	
		(d) Research Approaches	
II	**Fundamentals of Research in Mathematics**		13
	1	**Research Process in Mathematics**	
	2	**Formulating research problems**	
		(a) Selecting the problem	
		(b) Techniques involved in defining the problem	
	3	**Ethics in mathematical research**	
		(a) Plagiarism	
		(b) Copyright	

III		**Methodologies and Tools in Mathematical Research**	14
	1	**Literature Survey**	
		(a) Importance of literature survey	
		(b) Techniques for literature survey	
		(c) Use of databases: MathSciNet, arXiv, Google Scholar	
		(d) Impact factor	
	2	**Methodology and Tools**	
		(a) Reading, analyzing, and synthesizing mathematical papers	
		(b) Definitions, theorems and proofs	
		(c) Proof techniques: direct, indirect, contradiction, induction	
		(d) Mathematical modeling: from problem to formulation	
		(e) Constructive and non-constructive approaches	
		(g) Computational tools: MATLAB, Python (NumPy/SymPy), Mathematica	
IV		**Report Writing**	14
	1	(a) Significance of Report writing	
		(b) Different steps in writing Report	
		(c) Layout of a Thesis	
		(d) Types of Research Reports	
		(e) LaTeX for scientific writing	
		(d) Referencing and citation styles (BibTeX)	
V		**Teacher Specific Module**	5
		Directions	
		Writing and presenting a Research Proposal	

Suggested Readings

1. C.R. Kothari and Gaurav Garg, Research methodology- Methods and Techniques, 4^{th} ed, New Age International Pvt. Ltd
2. Donald E. Knuth, Mathematical Writing
3. J. A. Dieudonne, M. M. Schiffer, N. E. Steenrod, P. R. Halmos, How to Write Mathematics, American Mathematical Society
4. A Mathematician's Survival Guide, Steven G. Krantz American Mathematical Society
5. Handbook of Writing for the Mathematical Sciences (3^{rd} edition), Nicholas J. Higham, Siam.
6. Proofs from THE BOOK, Martin Aigner and Günter M. Ziegler, Springer.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper	10
b)	Assignment	5
c)	Seminar	5
d)	Book/ Article Review	5
e)	Viva-Voce	5
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU8DSEMAT402: ANALYTIC NUMBER THEORY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSE	400-499	KU8DSEMAT402	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

Analytic Number Theory is a rigorous course that applies tools from mathematical analysis to study the properties of integers, particularly the distribution of prime numbers. The course covers Arithmetic functions, Congruences, Quadratic residues and primitive roots.

Course Prerequisite

Elementary number theory.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Mobius function, Euler totient function and relation connecting them	Understand
2	Understand Dirichlet product of arithmetical functions	Understand
3	Comprehend basic properties of congruences, Linear congruences	Understand
4	Apply Chinese remainder theorem	Apply
5	Understand Quadratic Residues and the Quadratic Reciprocity Law	Understand
6	Comprehend the existence and nonexistence of primitive roots	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Arithmetical Functions and Dirichlet multiplication**	14
	1	Introduction, The Mobius function $\mu(n)$, The Euler totient function $\phi(n)$, A relation connecting μ and ϕ and a product formula for $\phi(n)$	
	2	The Dirichlet product of arithmetical functions, Dirichlet inverses and the Mobius inversion formula	
	3	The Mangoldt function , Multiplicative functions and Dirichlet multiplication	
	4	The inverse of a completely multiplicative function, Liouville's function and the divisor functions	
II		**Congruences**	14
	1	Basic properties of congruences, Residue classes and complete residue systems	
	2	Linear congruences, Reduced residue systems and the Euler-Fermat theorem	
	3	Polynomial congruences modulo p, Lagrange's theorem and applications of Lagrange's theorem	
	4	Simultaneous linear congruences. The Chinese remainder theorem, Applications of the Chinese remainder theorem	
III		**Quadratic Residues and the Quadratic Reciprocity Law**	13
	1	Quadratic residues, Legendre's symbol and its properties	
	2	Evaluation of (- 1/p) and (2/p), Gauss' lemma	
	3	The quadratic reciprocity law, Applications of the reciprocity law	
	4	The Jacobi symbol, Applications to Diophantine equations	
IV		**Primitive Roots**	14
	1	The exponent of a number mod m, Primitive roots and reduced residue systems	
	2	The nonexistence of primitive roots mod 2^{α} for $\alpha \geq 3$ and the existence of primitive roots mod p for odd primes p	
	3	Primitive roots and quadratic residues. The existence of primitive roots mod p^{α} and mod $2p^{\alpha}$	
	4	The nonexistence of primitive roots in the remaining cases, The number of primitive roots mod m	

V	**Teacher Specific Module**	**5**
	Directions	
	Polynomial congruences with prime power moduli	

Essential Readings

1. T.M. Apostol, Introduction to Analytic Number Theory, Springer

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 2.1 to 2.5	
	2	1	Sections 2.6 to 2.7	
	3	1	Sections 2.8 to 2.10	
	4	1	Section 2.11 to 2.13	
II	1	1	Sections 5.1 to 5.2	
	2	1	Sections 5.3 to 5.4	
	3	1	Sections 5.5 to 5.6	
	4	1	Sections 5.7 to 5.8	
III	1	1	Sections 9.1 to 9.2	
	2	1	Sections 9.3 to 9.4	
	3	1	Sections 9.5 to 9.6	
	4	1	Sections 9.7 to 9.8	
IV	1	1	Sections 10.1 to 10.2	
	2	1	Sections 10.3 to 10.4	
	3	1	Sections 10.5 to 10.7	
	4	1	Sections 10.8 to 10.9	

Suggested Readings

1. David M Burton, Elementary Number theory,7th edition, Mc Graw Hill
2. G.H Hardy and E M Wright, Introduction to the theory of numbers, Oxford International Edn, 1985
3. Hurwitz & N Kritiko, Lecturers on Number Theory, Springer Verlang 1986

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU8DSEMAT403

ADVANCED OPTIMIZATION METHODS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSE	400-499	KU8DSEMAT403	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4		1	30	70	100	2

Course Description

This course provides an in-depth exploration of advanced optimization techniques used to model, analyze, and solve complex decision-making problems in engineering, management, and applied sciences. Building upon fundamental optimization concepts, the course covers Integer Programming for discrete decision problems, Game Theory for strategic interactions and competitive environments, Queueing Theory for stochastic system analysis, and Nonlinear Programming for handling optimization models with non-linear relationships.

Students will develop a strong theoretical foundation along with practical skills in formulating and solving real-world problems using mathematical models.

Course Prerequisite

Basic knowledge of Operations Research

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Formulate and solve integer programming problems	Apply
2	Analyze strategic interactions using game theory	Analyze
3	Model and evaluate queuing systems	Analyze
4	Solve nonlinear optimization problems	Apply
5	Interpret and apply optimization methods to real-world problems	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓		✓				
CO 3	✓		✓				
CO 4	✓		✓				
CO 5	✓		✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**INTEGER PROGRAMMING**	14
	1	(a) Pure and Mixed Integer Programming Problems	
		(b) Gomory's All-IPP Method	
		(c) Construction of Gomory's Constraints	
		(d) Fractional Cut Method – All Integer LPP	
		(e) Fractional Cut Method – Mixed Integer LPP	
		(f) Branch and Bound Method	
		(g) Applications of Integer Programming	

II	**GAMES AND STRATEGIES**		13
	1	a) Two-person Zero-sum Games, Basic terms in Game theory	
		b) The Maximin Minimax Principle, Solution of game with saddle point	
		c) Solution of 2 x 2 game without saddle point	
		d) Graphic solution of 2 x *n* and *m* x 2 games	
		e) Dominance Property, and Modified Dominance Property	
		(f) Arithmetic Method for *n* x *n* Games.	
III	**QUEUEING THEORY**		14
	1	(a) Queueing System	
		(b) Elements of Queueing System	
		(c) Operating Characteristics of a Queueing System	
		(d) Deterministic Queueing System	
		(e) Probability Distributions in Queueing Systems	
		(f) Classification of Queuing Models	
		(g) Definition of Transient and Steady States	
		(h) Poisson Queueing Systems	
IV	**NON-LINEAR PROGRAMMING**		14
	1	(a) Formulating a Non-Linear Programming Problem (*NLPP*)	
		(b) General Non-Linear Programming Problem	
	2	(c) Constrained Optimization with Equality Constraints	
		(d) Constrained Optimization with Inequality Constraints	
V	**Teacher Specific Module**		**5**
	Directions		
	General Solution of *m* x *n* Rectangular Games		
	Non-Poisson Queueing Systems		
	Quadratic Programming		

Essential Readings

1. K. Swarup, P.K.Gupta and M. Mohan, Operations Research (18^{th} edition), Sulthan Chand and Sons.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 7:1, 7:2, 7:3, 7:4, 7:5, 7:6, 7:7, 7:8	
II	1	1	Sections 17:1, 17:2, 17:3, 17:4, 17:5, 17:6, 17:7	
III	1	1	Sections 21:1, 21:2, 21:3, 21:4, 21:5, 21:6, 21:7, 21:8, 21:9	
IV	1	1	Sections 27:1, 27:2, 27:3, 27:4, 27:5	

Suggested Readings

1. J.K. Sharma, Operations Research - Theory and Applications, McMillan
2. H.A. Thaha, Operations Research, An Introduction (8^{th} edition), Prentice Hall
3. G. Hadley, Linear Programming, Oxford & IBH Publishing Company.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper *	12
b)	Assignment	6
c)	Seminar,	6
d)	Viva-Voce	6
Total		**100**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

MULTIDISCIPLINARY COURSES

KU1MDCMAT101:
MATHEMATICS IN REAL LIFE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	MDC	100-199	KU1MDCMAT101	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course is designed to equip students with essential knowledge and skills required to excel quantitative reasoning and arithmetic operations which in turn develop speed and accuracy also In addition, the course consists of practical applications of quantitative arithmetic in finance business and science.

Course Prerequisite

Basic operations in mathematics

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend numbers, HCF and LCM of numbers and fractions and Decimals	Understand
2	Understand Average, Problems on ages and Percentage	Understand
3	Understand Profit and loss, Ratio and proportion and Chain rule	Understand
4	Comprehend Time and work, Time and distance and Problems on trains and solves problems	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2			✓				

CO 3			✓				
CO 4			✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	1	Numbers	12
	2	HCF and LCM of numbers	
	3	Decimal fractions	
II	1	Average	11
	2	Problems on ages	
	3	Percentage	
III	1	Profit and loss	11
	2	Ratio and proportion	
	3	Chain rule	
IV	1	Time and work	11
	2	Time and distance	
	3	Problems on trains	

Essential Readings

R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand.

Reference Distribution

Module	Unit	Reference No.	Chapters	Remarks
I	1	1	Chapter 1	

	2	1	Chapter 2	
	3	1	Chapter 3	
II	1	1	Chapter 6	
	2	1	Chapter 8	
	3	1	Chapter 10	
III	1	1	Chapter 11	
	2	1	Chapter 12	
	3	1	Chapter 14	
IV	1	1	Chapter 15	
	2	1	Chapter 17	
	3	1	Chapter 18	
V	**Teacher specific module**			

Suggested Readings

1. Quantitative Aptitude for Competitive Examinations, A. Guha (7th edition), Mc Graw Hill
2. Fast Track Objective Mathematics, R. Verma (Revised edition), Arihant.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	5
c)	Seminar, Viva-Voce	10
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Calculators shall *not* be permitted.**

KU1MDCMAT102:
BUSINESS MATHEMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	MDC	100-199	KU1MDCMAT102	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course provides students with a solid foundation in mathematical techniques and applications needed to handle complex business situations.

Course Prerequisite

Basic understanding of algebra and arithmetic.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend straight lines	Understand
2	Formulate mathematical models using linear functions and solve real world problems	Apply
3	Comprehend different types of systems of linear equations	Understand
4	Solve systems of linear equations	Understand
5	Apply matrix theory to study the relationship between industry production and consumer demand – Leontief input-output model	Apply
6	Solve linear programming problems graphically	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2				✓			
CO 3	✓						
CO 4	✓						
CO 5				✓			
CO 6	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
I	**Geometry**		11
	1	The Cartesian coordinate system	
	2	Straight lines	
	3	Linear functions and mathematical models	
II	**Linear equations**		11
	1	Systems of linear equations: An introduction	
	2	Systems of linear equations: Unique solutions	
	3	Systems of linear equations: Undetermined and overdetermined systems	
III	**Matrices**		12
	1	Matrices	

	2	Multiplication of matrices	
	3	The inverse of a square matrix	
	4	Leontief input-output model	
IV	**Linear Programming**		11
	1	Linear programming – A geometric approach	

Essential Readings

1. Soo T. Tan, Finite Mathematics for the Managerial, Life and Social Sciences (11th edition), Cengage Learning.

Reference Distribution

Module	Unit	Reference No.	Chapters/Sections	Remarks
I	1	1	Section 1.1	
	2	1	Section 1.2	
	3	1	Section 1.3	
II	1	1	Section 2.1	
	2	1	Section 2.2	
	3	1	Section 2.3	
III	1	1	Section 2.4	
	2	1	Section 2.5	
	3	1	Section 2.6	
	4	1	Section 2.7	
IV	1	1	Chapter 3	

Suggested Readings

1. B. M. Aggarwal, Business Mathematics and Statistics, Ane Books Pvt. Ltd., 2013
2. A. C. Chiang and K. Wainwright, Fundamental Methods of Mathematical Economics
3. A. Francis, Business Mathematics and Statistics (6th edition), ThomsonLearning, 2004

4. B.N. Gupta, Business Mathematics and Statistics, SBPD Publications, 2021
5. Knut Sydestar and Peter Hummond with Arne Storm, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	5
c)	Seminar, Viva-Voce	10
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.

KU1MDCMAT103: MATRIX THEORY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	MDC	100-199	KU1MDCMAT103	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course provides an introduction to matrices. Emphasis is placed on the development of concepts and applications for systems of equations, matrices, determinants, and orthogonality.

Course Prerequisite

Matrix algebra.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Recognise consistent and inconsistent systems of equations by the row echelon form of the augmented matrix	Understand
2	Able to solve a system of m linear equations in n unknowns using Gaussian elimination	Understand
3	Understand how elementary matrix are used for row operations and find the inverse of a matrix using row operations	Understand
4	Understand the concept ‘Rank of a matrix’.	Understand
5	Consistency of a system of linear equations using rank	Understand

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓		✓			✓	
CO 3	✓	✓					
CO 4	✓						
CO 5	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Systems of linear equations, Row operations**	11
	1	Systems of linear equations	
	2	Row operations	
II		**Gaussian elimination, homogeneous systems and null spaces**	12
	1	**Gaussian elimination**	
		a) The algorithm: reduced row echelon form Consistent and inconsistent systems	
		b) Linear systems with free variables	
		c) Solution sets	
	2	**Homogeneous systems and null spaces**	
		a) Homogeneous systems	
		b) Null space	
III	1	**Matrix inversion**	11

	1	a) Matrix inverse using row operations	
		b) Row equivalence	
		c) The main theorem	
		d) Using row operations to find the inverse matrix	
IV	**The rank of a matrix, Rank and systems of linear equations, Range**		**11**
	1	The rank of a matrix	
	2	Rank and systems of linear equations	
		a) General solution and rank	
		b) General solution in vector notation	
	3	Range	

Essential Reading

1. Martin Anthony and Michele Harvey Linear Algebra: Concepts and Methods, Cambridge University Press 2012.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Section 2.1	
	2	1	Section 2.2	
II	1	1	Section 2.3	Proof of Theorem 2.17 omitted.
	2	1	Section 2.4	Proof of Theorem 2.21 and Theorem 2.29 omitted.
III	1	1	Section 3.1	Proof of all the theorems in this section omitted
IV	1	1	Section 4.1	Proof of Theorem 4.5 omitted.
	2	1	Section 4.2	
	3	1	Section 4.3	

Suggested Readings

1. Jeffrey Holt; Linear Algebra with Applications; W.H Freeman & Company, New York

2. T.S Blyth and E F Robertson: Basic Linear Algebra; Springer 2002
3. Charu C Agarwal; Linear Algebra and Optimization for Machine Learning; Springer; 2020
4. Nathen Carter; Data Science for Mathematicians; CRC Press/ Chapman and Hall Handbooks in Mathematics series 2021.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	5
c)	Seminar, Viva-Voce	10
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

****Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2MDCMAT101:
MATHEMATICAL REASONING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	MDC	100-199	KU2MDCMAT101	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

Mathematical reasoning is an essential course designed to cultivate ability of students to think critically and analytically through mathematical techniques. The course emphasises the development of logical reasoning skills, problem solving techniques and communication of mathematical ideas.

Course Prerequisite

Basic arithmetic operations

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Recognize the underlying mathematical relationships and sequences governing the progression of numbers in the series	Understand
2	Recognize numerical patterns and relationships between sets of numbers	Understand
3	Recognize the rules or algorithms governing the coding process and apply them to decode encrypted information	Apply
4	Recognize accurate Venn diagrams that effectively illustrate the relationships between different sets and their elements.	Understand
5	Find out how many times a number occurs in a given long series of numbers, satisfying specified conditions	Understand
6	Comprehend ranking test	Understand

7	Read and use Bar graphs, Pie graphs and Venn diagrams.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1		✓					
CO 2		✓					
CO 3		✓					
CO 4	✓	✓					
CO 5		✓					
CO 6		✓					
CO 7		✓					

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Mathematical Mental Ability I**	12
	1	Number series completion	
	2	Number Analogy	
II		**Mathematical Mental Ability II**	11
	1	Coding-Decoding : Number/symbol coding	
	2	Logical Venn diagram	
III		**Mathematical Mental Ability III**	11
	1	Number test	
	2	Ranking test	

IV	**Data interpretation**		11
	1	Bar graphs	
	2	Pie graphs	
	3	Line graphs	

Essential Readings

1. R.S. Aggarwal, A modern approach to Verbal and Nonverbal Reasoning, Revised Edition (2018), S. Chand
2. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand.

Reference Distribution

Module	Unit	Reference No.	Chapters	Remarks
I	1	1	Type 1 in Chapter 1	
	2	1	Type 8 in Chapter 2	
II	1	1	Type 3 in Chapter 4	
	2	1	Chapter 9	
III	1	1	Type 1 in Chapter 12	
	2	1	Type 2 in Chapter 12	
IV	1	2	Chapter 37	
	2	2	Chapter 38	
	3	2	Chapter 39	

Suggested Readings

1. Gautam Puri, Reasoning for competitive examinations, 2023, GK Publishers
2. R.K. Thakur, A latest approach to verbal and nonverbal reasoning, Prabhat Prakashan.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Calculators shall not be permitted.**

KU2MDCMAT102:
MATHEMATICS FOR SOCIAL SCIENCE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	MDC	100-199	KU2MDCMAT102	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

The course aims to develop students' mathematical literacy and critical thinking skills in the context of Social Science. This course provides an introduction to basic mathematical concepts used in Social Sciences. It covers fundamental concepts in Algebra and Calculus. Topics include sets, functions, differentiation, integration and matrices with applications to Business and Finance.

Course Prerequisite

Real number system.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand sets and set operations	Understand
2	Comprehend functions	Understand
3	Understand limits, derivatives and techniques for differentiation	Understand
4	Understand indefinite integrals	Understand
5	Comprehend matrices, different types of matrices and matrix operations	Understand
6	Compute determinants of 2×2 and 3×3 matrices	Understand
7	Determine inverse of a non-singular matrix	Understand
8	Apply matrices and determinants to Business and Finance	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓						
CO 3	✓						
CO 4	✓						
CO 5	✓						
CO 6	✓						
CO 7	✓						
CO 8						✓	

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Sets and Functions**		11
	1	Sets and set operations	
	2	Functions	
II	**Limits and Derivatives**		11
	1	Limits	
	2	Differentiation (a) The derivative (b) Techniques of differentiation (c) Product and quotient rules	
III	**Integration**		11
	1	Indefinite integrals (a) Indefinite integrals and differential equations	
IV	**Matrices and its applications to Business and Economics**		12

	1	Matrices (a) Matrices, row matrix, column matrix, submatrix, equal matrices (b) Addition, subtraction and multiplication of matrices (c) Identity matrix, null matrix, diagonal matrix, scalar matrix, transpose of a matrix	
	2	Determinants (a) Determinants of 2×2 and 3×3 matrices (b) Minors, cofactors and cofactor expansion	
	3	Inverse of a matrix (a) Inverse of a matrix (b) Singular and non-singular matrices (c) Cofactor matrix (d) Adjoint matrix (e) Inverse of a matrix by adjoint method	
	4	Applications of matrices and determinants to Business and Finance	

Essential Readings

1. Soo T. Tan, Finite Mathematics for the Managerial, Life and Social Sciences (11th edition), Cengage Learning
2. L. Hoffman, G. Bradley, D. Sobechi and M.Price, Calculus for Business, Economics, and Social and Life Sciences: Brief edition (11th edition), Mc Graw Hill
3. B.M. Aggarwal, Business mathematics & Statistics, Ane Books Pvt. Ltd.

Reference Distribution

Module	Unit	Reference No.	Chapters/Sections	Remarks
I	1	1	Section 6.1	
	2	2	Section 1.1	
II	1	2	Section 1.5	
	2	2	Sections 2.1, 2.2, 2.3	*Higher order derivatives in Section 2.3 is omitted*
III	1	2	Section 5.1	
IV	1	3	Sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.9, 1.10, 1.11, 1.12, 1.13	
	2	3	Section 1.16	
	3	3	Sections 1.15, 1.25, 1.27, 1.28, 1.29	
	4	3	Chapter 2	*Examples 2,3,4,5 & 6 only*

Suggested Readings

1. M. Wilson, Business Mathematics, Himalaya Publishing House
2. G. Rangaraj, R. Mallieswari and V. Rema, Business Mathematics, Cengage
3. P. Hazarika, A text book of Business Mathematics (4th edition), S. Chand
4. S. Sarma and B. Baruah, Business Mathematics, Mahaveer Publications
5. J.K. Sharma, Business Mathematics (3rd edition), Techsar Pvt. Ltd.

Assessment Rubrics

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

****Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

KU2MDCMAT103: VECTOR ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	MDC	100-199	KU2MDCMAT103	3	45
Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course aims to introduce the concepts of vectors, vector operations, dot product and cross product of two vectors, scalar and vector triple product and applications.

Course Prerequisite

Basic knowledge in Rectangular Cartesian System.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the basics of vectors and vector operations	Understand
2	Comprehend the right and left handed systems	Understand
3	Understand dot product, cross product and box product of vectors	Understand
4	Apply the known concepts to illustrate some situations	Apply
5	Understand miscellaneous applications	Apply

Mapping of Course Outcomes to PSOs							
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2						✓	
CO 3	✓						
CO 4	✓						
CO 5	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Vectors: Basic concepts**		**15**
	1	a) Fundamental concepts and definitions	
		b) Vector operations	
		c) Right handed and Left handed system	
		d) Linear dependence of vectors	
II	**Product of vectors**		**15**
	1	a) Dot product of two vectors	
		b) Projection of a vector on an axis	
		c) Cross product of two vectors	
		d) Scalar triple product	
III	**Miscellaneous applications**		**15**
	1	a) Vector triple product	
		b) Vector and Cartesian equation of lines and planes in space	
		c) Example	
		d) Miscellaneous applications	

Essential Readings

1. Demetrios P Kanoussis, Vector Algebra - for Engineers and Scientists.

Reference Distribution

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Chapters 1, 2, 3, 4.	
II	1	1	Chapters 5, 6, 7, 8.	
III	1	1	Chapter 9, 10, 11.	

Suggested Readings

1. James Stewart; Calculus: Early Transcendentals; 9th edition; Cengage learning, 2021
2. G. B. Thomas Jr, M. D. Weir and Joel R. Hass; Thomas' Calculus; 12th edition; Pearson 2009
3. H. Anton, I. Bivens, S. Davis; Calculus; 10th edition; Wiley.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Scientific Calculators below 100 functions (that is, upto *fx 99*) shall be permitted.**

VALUE ADDED COURSES

KU3VACMAT201

QUANTITATIVE ARITHMETIC

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	VAC	200-299	KU3VACMAT201	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course is designed to equip students with essential knowledge and skills required to excel quantitative reasoning and arithmetic operations which in turn develop speed and accuracy also In addition, the course consists of practical applications of quantitative arithmetic in finance business and science.

Course Prerequisite

Basic operations in mathematics

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend numbers, HCF and LCM of numbers and fractions and Decimals	Understand
2	Understand Average, Problems on ages and Percentage	Understand
3	Understand Profit and loss, Ratio and proportion and Chain rule	Understand
4	Comprehend Time and work, Time and distance and Problems on trains and solves problems	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2			✓				

CO 3			✓				
CO 4			✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	1	Numbers	12
	2	HCF and LCM of numbers	
	3	Decimal fractions	
II	1	Average	11
	2	Problems on ages	
	3	Percentage	
III	1	Profit and loss	11
	2	Ratio and proportion	
	3	Chain rule	
IV	1	Time and work	11
	2	Time and distance	
	3	Problems on trains	

Essential Readings

R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand.

Reference Distribution

Module	Unit	Reference No.	Chapters	Remarks
I	1	1	Chapter 1	

	2	1	Chapter 2	
	3	1	Chapter 3	
II	1	1	Chapter 6	
	2	1	Chapter 8	
	3	1	Chapter 10	
III	1	1	Chapter 11	
	2	1	Chapter 12	
	3	1	Chapter 14	
IV	1	1	Chapter 15	
	2	1	Chapter 17	
	3	1	Chapter 18	

Suggested Readings

1. Quantitative Aptitude for Competitive Examinations, A. Guha (7th edition), Mc Graw Hill
2. Fast Track Objective Mathematics, R. Verma (Revised edition), Arihant.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Calculators shall *not* be permitted.**

KU3VACMAT202: MATHEMATICAL LOGIC

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	VAC	200-299	KU3VACMAT202	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course provides a foundational introduction to the concepts of set theory and formal logic, essential for higher-level mathematics, computer science, and analytical thinking. Topics include basic set operations and an introduction to propositional logic.

Course Prerequisite

Basic high school Algebra.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the basic operations and properties of sets, including union, intersection, complement, Cartesian products, and power sets	Understand
2	Analyze and construct formal logical arguments using propositional and predicate logic	Analyze
3	Translate between natural language statements and formal logic expressions	Understand
4	Determine the validity of logical statements and use truth tables, tautologies, and logical equivalences effectively.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓					
CO 2	✓	✓					

CO 3	✓	✓					
CO 4	✓	✓					

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Sets and Basic Operations on Sets**	**11**
	1	(a) Sets and elements	
		(b) Universal set, Empty set	
		(c) Subsets	
		(d) Venn diagrams	
		(e) Set operations	
		(f) Algebra of sets	
II		**Logic and Propositional Calculus I**	**12**
	1	(a) Propositions and Compound propositions	
		(b) Basic Logical operations	
		(c) Propositions and Truth tables	
		(d) Tautologies and Contradictions	
III		**Logic and Propositional Calculus II**	**11**
	1	(a) Logical equivalence	
		(b) Algebra of propositions	
		(c) Conditional and Biconditional statements	
		(d) Arguments	
IV		**Logic and Propositional Calculus III**	**11**
	1	(a) Logical implication	
		(b) Propositional functions, Quantifiers	
		(c) Negation of Quantified statements	

Essential Readings

1. Seymour Lipschitz, Set theory and related topics, 2nd ed., Schaum's Outline series, Tata McGraw Hill, 1998.

Reference Distribution

Module	Unit	Reference No.	Sections	Remarks
I	1	1	Sections 1.1, 1.2, 1.3, 1.4, 1.4, 1.5, 1.6, 1.7	
II	1	1	Sections 10.1, 10.2, 10.3, 10.4, 10.5	
III	1	1	Sections 10.6, 10.7, 10.8, 10.9	
IV	1	1	Sections 10.10, 10.11, 10.12	

Suggested Readings

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 8th ed., McGraw Hill
2. Daniel J. Velleman, How to Prove It: A Structured Approach, 2nd ed (2006), Cambridge University Press
3. Douglas Smith, Maurice Eggen, Richard St. Andre, A Transition to Advanced Mathematics, Cengage Learning, 8th ed. (2006)
4. Richard Johnsonbaugh, Discrete Mathematics, Pearson Education, 7th ed.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU4VACMAT201: MATHEMATICAL REASONING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	VAC	200-299	KU4VACMAT201	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

Mathematical reasoning is an essential course designed to cultivate ability of students to think critically and analytically through mathematical techniques. The course emphasises the development of logical reasoning skills, problem solving techniques and communication of mathematical ideas.

Course Prerequisite

Basic arithmetic operations

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Recognize the underlying mathematical relationships and sequences governing the progression of numbers in the series	Understand
2	Recognize numerical patterns and relationships between sets of numbers	Understand
3	Recognize the rules or algorithms governing the coding process and apply them to decode encrypted information	Apply
4	Recognize accurate Venn diagrams that effectively illustrate the relationships between different sets and their elements.	Understand
5	Find out how many times a number occurs in a given long series of numbers, satisfying specified conditions	Understand
6	Comprehend ranking test	Understand

7	Read and use Bar graphs, Pie graphs and Venn diagrams.	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1		✓					
CO 2		✓					
CO 3		✓					
CO 4	✓	✓					
CO 5		✓					
CO 6		✓					
CO 7		✓					

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Mathematical Mental Ability I**	12
	1	Number series completion	
	2	Number Analogy	
II		**Mathematical Mental Ability II**	11
	1	Coding-Decoding : Number/symbol coding	
	2	Logical Venn diagram	
III		**Mathematical Mental Ability III**	11
	1	Number test	
	2	Ranking test	

IV	**Data interpretation**			11
	1	Bar graphs		
	2	Pie graphs		
	3	Line graphs		

Essential Readings

1. R.S. Aggarwal, A modern approach to Verbal and Nonverbal Reasoning, Revised Edition (2018), S. Chand
2. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand.

Reference Distribution

Module	Unit	Reference No.	Chapters	Remarks
I	1	1	Type 1 in Chapter 1	
	2	1	Type 8 in Chapter 2	
II	1	1	Type 3 in Chapter 4	
	2	1	Chapter 9	
III	1	1	Type 1 in Chapter 12	
	2	1	Type 2 in Chapter 12	
IV	1	2	Chapter 37	
	2	2	Chapter 38	
	3	2	Chapter 39	

Suggested Readings

1. Gautam Puri, Reasoning for competitive examinations, 2023, GK Publishers
2. R.K. Thakur, A latest approach to verbal and nonverbal reasoning, Prabhat Prakashan.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

** **Use of Calculators shall not be permitted.**

KU4VACMAT202: GRAPH THEORY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	VAC	200-299	KU4VACMAT202	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3		1	25	50	75	1.5

Course Description

This course is designed to equip students with essential knowledge and skills required to excel in applying techniques of Graph Theory to solve real life problems which in turn develop their skills in finding solution to such problems. The applications extend to all walks of life.

Course Prerequisite

Basic skills in converting real life problems to mathematical models.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand how to transform daily life problems into Graph Theoretical (Mathematical) Models	Understand
2	Understand the evolution of Graph Theory as a subject	Understand
3	Understand the representation of Chinese Postman Problem, Marriage Problem, Travelling Salesman Problem and Personnel Assignment Problem	Understand
4	Understand the concepts of planar graphs and Jordan curve	Understand
5	Understand Problem of colouring maps and Graph Colouring	Understand

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			

CO 2	✓		✓	✓			
CO 3	✓		✓	✓			
CO 4	✓		✓	✓			
CO 5	✓		✓	✓			

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	1	Representing a telephone network so as to identify vulnerability to accidental disruption	12
	2	Representing a set of jobs and a set of people so as to assign jobs to qualified persons	
	3	Representing a salesman's destinations in such a way that a shortest round trip through all destinations can be found out	
	4	Representing supply lines of electricity, gas and water so that each house gets the supply and the lines do not cross	
	5	Representing radio frequencies to assign frequencies to radio or TV broadcasting companies so that the frequencies do not interfere with each other	
	6	Representing the air route between cities so as to find out the cheapest route between cities	
II	1	Konigsberg bridge problem	11
	2	Checking whether it is possible to draw a closed figure without lifting pencil from the paper – Euler graph	
	3	Finding the shortest path for a postman to start from his Post Office, deliver the letters and return to the Post Office – Chinese Postman Problem.	
	4	Finding the path of minimum total distance for a travelling salesman involving a number of towns – Travelling Salesman Problem	
III	1	Representing the problem of getting a set of boys married with a set of girls in such a way that a boy is married to his girlfriend – Marriage problem	11
	2	Representing the problem of assigning qualified teachers to a set of classes – Personnel Assignment Problem	
	3	The problem whether we can join points inside a continuous non self intersecting curve whose origin and terminus coincide with a point exterior to it – Jordan curve theorem	

IV	1	The fact that there are only five regular polyhedra	**11**
	2	The problem of colouring maps – Graph Colouring	
	3	Representing the streets of a city in such a way that one can drive from any part of the city to any other part	

Essential Readings

1. A First Look at Graph Theory, John Clark and Derek Allan Holton, Allied Pub., 1995

Reference Distribution

Module	Unit	Reference No.	Chapters	Remarks
I	1	1	1.2	*Necessary concepts may be introduced by the teacher to supplement the content. However, Theorems and their proofs are not included in the syllabus.*
	2	1	1.2	
	3	1	1.2	
	4	1	1.2	
	5	1	1.2	
	6	1	1.2	
II	1	1	3.1	
	2	1	3.1	
	3	1	3.2	
	4	1	3.4	
III	1	1	4.2	
	2	1	4.3	
	3	1	5.1	
IV	1	1	5.3	
	2	1	6.1, 6.6	
	3	1	7.4	

Suggested Readings

1. R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory (2nd edition), Springer.
2. F. Harary, Graph Theory, Narosa Pub. House
3. K.R. Parthasarathy, Basic Graph Theory, Tata-McGraw Hill.

Assessment Rubrics

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper *	10
b)	Assignment	10
c)	Seminar, Viva-Voce	5
Total		**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU4VACMAT203: LaTeX

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	VAC	200-299	KU4VACMAT203	2 + 1	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5

Course Description

This course provides students with a solid foundation in techniques and applications needed to handle LaTeX software for the preparation of articles or books.

Course Prerequisite

Higher Secondary Level Mathematics.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand basics of LaTeX	Understand
2	Learn document formatting in LaTeX through various examples	Apply
3	Learn creating Tables & Figures in LaTeX through various examples	Understand
4	Understand using Math Mode in LaTeX through various examples	Understand
5	Learn the content through practicing examples to create LaTeX	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2				✓			
CO 3	✓						
CO 4	✓						

CO 5				✓			

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Getting Started (Basics of LaTeX)**	11
	1	**Hello World** – Your first LaTeX document (article class) • Structure: \documentclass, \begin{document}, \end{document}	
	2	**Sections & Paragraphs** • Using \section, \subsection, \paragraph	
	3	**Text Formatting** • Bold, italics, underline, font sizes, color	
	4	**Lists** • **Itemize, enumerate, and description environments**	
	5	**Adding Comments & Packages** • **% for comments, \usepackage basics**	
II		**Document Formatting**	11
	1	**Title, Author, Date** • \title, \author, \date, and \maketitle	
	2	**Page Layout & Margins** • Using geometry package to customize margins	
	3	**Custom Headers & Footers** • Using fancyhdr to personalize page style	
	4	**Footnotes & Emphases** • Adding \footnote, \emph, custom commands	

	5	**Multicolumn Layout** • Using multicol package	

III	**Tables & Figures**		**12**
	1	**Basic Tables** • Using tabular environment	
	2	**Advanced Tables** • Merging cells with multirow, multicolumn, booktabs	
	3	**Inserting Images** • graphicx package, \includegraphics	
	4	**Figure Environments & Captions** • figure, \caption, \label, \ref	
	5	**Wrapping Text Around Images** • Using wrapfig package	
IV	**Math Mode**		**11**
	1	**Inline & Display Math** • \(... \), \[... \], equation environment	
	2	**Common Symbols** • Greek letters, sums, integrals, fractions	
	3	**Aligning Equations** • Using align and align* from amsmath	
	4	**Matrices** • bmatrix, pmatrix, using amsmath	
	5	**Theorems, Lemmas, and Proofs** • amsthm package and environments	

V		**Teacher Specific Module**	**15**
		Directions for Practicals: ***Students are required to submit output of at least 15 problems from following four modules.***	
		Module 1: Getting Started (Basics) **1. Hello World – Your first LaTeX document (article class** **2. Sections & Paragraphs** – Using \section, \subsection, \paragraph **3. Text Formatting – Bold, italics, underline, font sizes, color.** **4. Lists –** Itemize, enumerate, and description environments **5. Adding Comments & Packages** – % for comments, \usepackage	
		Module 2: Document Formatting **1. Title, Author, Date** – \title, \author, \date, \maketitle **2. Page Layout & Margins** – Using geometry package **3. Custom Headers & Footers** – Using fancyhdr **4. Footnotes & Emphases** – \footnote, \emph **5. Multicolumn Layout –** Using multicol package	
		Module 3: Tables & Figures **1. Basic Tables** – Using tabular environment **2. Advanced Tables –** Merging cells with multirow, multicolumn, booktabs **3. Inserting Images – graphicx package** **4. Figure Environments & Captions –** figure, \caption, \label **5. Wrapping Text Around Images** – Using wrapfig package	
		Module 4: Math Mode **1. Inline & Display Math** – $...$, \[...\], equation **2. Common Symbols –** Greek letters, sums, integrals, fractions **3. Aligning Equations** – Using align and align* from amsmath **4. Matrices –** bmatrix, pmatrix **5. Theorems, Lemmas, and Proofs** – amsthm package	

Essential Readings

1. LaTeX - A Document Preparation System User's Guide and Reference Manual - Leslie Lamport. Digital Equipment Corporation, Addison-Wesley Publishing Company, Reading, Massachusetts Menlo Park, California.

Suggested Readings

1. Modern LATEX, Matt Kline, Second edition (online pdf), typeset October 25, 2022.
2. The Not So Short Introduction to LATEX (or LATEX in 280 minutes), Tobias Oetiker, Marcin Serwin Hubert Partl, Irene Hyna, and Elisabeth Schlegl.
3. A Short Introduction to LaTeX, A book for beginners, Firuza Karmali
4. B.N. Gupta, Business Mathematics and Statistics, SBPD Publications, 2021
5. Knut Sydestar and Peter Hummond with Arne Storm, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson.

Assessment Rubrics

Evaluation Type	Marks
End Semester Evaluation (ESE)	**50 (35 T + 15 P)**
Continuous Evaluation (CCA)	**25 (15 T + 10 P)**
Theory (CCA)	**15**
(a) Test paper*	8
(b) Assignment	4
(c) Seminar/Viva-voce	3
Practical (CCA)	**10**
(a) Skill	6
(b) Record	4
Total	**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU4VACMAT204
MATHEMATICS IN REAL LIFE THROUGH GEOGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	VAC	200-299	KU4VACMAT204	2 + 1	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5

Course Description

This course introduces mathematical modeling and visualization using GeoGebra. through this interactive software. Learners will dynamically explore 2D and 3D geometry, algebraic expressions, calculus concepts, and real-life applications in finance, motion, and design.

Course Prerequisite

Basic mathematical operations and algebraic skills.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Use GeoGebra tools to construct and analyze geometric figures.	Apply
2	Explore functions, graphs, and algebraic relationships dynamically.	Apply
3	Apply calculus tools in GeoGebra to model and solve problems.	Apply
4	Visualize and build 3D mathematical models and real-life applications.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓			✓	✓		
CO 2	✓			✓	✓		
CO 3	✓			✓	✓		
CO 4	✓			✓	✓		

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Dynamic Geometry using GeoGebra**	7
	1	(a) GeoGebra interface and basic construction tools (b) Drawing points, lines, angles, triangles, and polygons (c) Constructing perpendiculars, bisectors, circles (d) Geometric transformations (translation, reflection, rotation) (e) Locus exploration and angle chasing	
II		**Algebra, Functions and Graphing**	7
	1	(a) Entering equations and manipulating variables (b) Graphs of linear, quadratic, exponential, and trigonometric functions (c) Using sliders to vary coefficients (d) Data entry, scatter plots, and regression models (e) Dynamic tables and linked equations	

III	**Calculus and Measurement**		**8**
	1	(a) Understanding limits visually (b) Graphing and interpreting derivatives (c) Tangents, secants, and slope fields (d) Definite integrals and area under curves (e) Riemann sum approximation	

IV	**Applications and 3D Visualization**		8
	1	(a) Introduction to 3D Graphics View in GeoGebra (b) Building 3D objects: cube, cylinder, cone, and sphere (c) Exploring real-life mathematical modeling: finance, motion, optimization (d) Using parametric equations for paths and simulations (e) Interactive math applets for concept demonstrations	

	Teacher specific module	**30**
	Directions for Practicals	
V	**1:** Construct a triangle and reflect it across one of its sides. Color code both triangles and display angle measures. **2:** Create a perpendicular bisector of a segment using compass and straightedge tools. Verify its property by checking distances from any point on it to endpoints. **3:** Explore triangle centers: construct the centroid, orthocenter, and circumcenter. Show how these change with vertex dragging **4:**Plot $f(x) = ax^2 + bx + c$ and explore how a, b, and c affect shape and position using sliders. **5:** Input population data into a table and create a scatter plot. Fit a best-fit exponential model. **6:** Explore the function $f(x) = \sin(kx)$ and see the wavelength change dynamically with slider k. **7:** Plot $f(x) = \sin x$, graph its derivative, and draw tangent lines at key points using GeoGebra's tools. **8:** Shade the area under $f(x) = x^2$ from $x = 0$ to $x = 4$ using the integral feature. **9:** Show left, right, and midpoint Riemann sums for $f(x) = \sqrt{x}$ and compare with definite integral **10:** Create a compound interest model using $A = P(1 + r)^t$ with sliders for P, r, and t. **11:** Model a projectile motion path with parametric equations. Ani- mate the projectile over time. **12:** Create a 3D solid of revolution using a profile curve and rotate around an axis. Adjust input function and limits interactively	

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Suggested Readings

1. Markus Hohenwarter et al., *GeoGebra Manual and Resources*, GeoGebra.org
2. Judith and Gary Kinsey, *Mathematics in Action Using GeoGebra*, Pearson

Assessment Rubrics

Evaluation Type	Marks
End Semester Evaluation (ESE)	**50 (35 T + 15 P)**
Continuous Evaluation (CCA)	**25 (15 T + 10P)**
Theory (CCA)	**15**
(a) Test paper*	8
(b) Assignment	4
(c) Seminar/Viva-voce	3
Practical (CCA)	**10**
(a) Skill	6
(b) Record	4
Total	**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

SKILL ENHANCEMENT COURSES

KU4SECMAT201
GEOGEBRA-BASED MATHEMATICAL VISUALIZATION AND APPLICATIONS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	SEC	200-299	KU4SECMAT201	2 + 1	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5

Course Description

This course introduces mathematical modeling and visualization using GeoGebra. through this interactive software. Learners will dynamically explore 2D and 3D geometry, algebraic expressions, calculus concepts, and real-life applications in finance, motion, and design.

Course Prerequisite

Basic mathematical operations and algebraic skills.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Use GeoGebra tools to construct and analyze geometric figures.	Apply
2	Explore functions, graphs, and algebraic relationships dynamically.	Apply
3	Apply calculus tools in GeoGebra to model and solve problems.	Apply
4	Visualize and build 3D mathematical models and real-life applications.	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓			✓	✓		
CO 2	✓			✓	✓		
CO 3	✓			✓	✓		
CO 4	✓			✓	✓		

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Dynamic Geometry using GeoGebra**	7
	1	(a) GeoGebra interface and basic construction tools (b) Drawing points, lines, angles, triangles, and polygons (c) Constructing perpendiculars, bisectors, circles (d) Geometric transformations (translation, reflection, rotation) (e) Locus exploration and angle chasing	
II		**Algebra, Functions and Graphing**	7
	1	(a) Entering equations and manipulating variables (b) Graphs of linear, quadratic, exponential, and trigonometric functions (c) Using sliders to vary coefficients (d) Data entry, scatter plots, and regression models (e) Dynamic tables and linked equations	

III	**Calculus and Measurement**		**8**
	1	(a) Understanding limits visually (b) Graphing and interpreting derivatives (c) Tangents, secants, and slope fields (d) Definite integrals and area under curves (e) Riemann sum approximation	
IV	**Applications and 3D Visualization**		8
	1	(a) Introduction to 3D Graphics View in GeoGebra (b) Building 3D objects: cube, cylinder, cone, and sphere (c) Exploring real-life mathematical modeling: finance, motion, optimization (d) Using parametric equations for paths and simulations (e) Interactive math applets for concept demonstrations	

V	**Teacher specific module**	**30**
	Directions for Practicals	
	1: Construct a triangle and reflect it across one of its sides. Color code both triangles and display angle measures. **2:** Create a perpendicular bisector of a segment using compass and straightedge tools. Verify its property by checking distances from any point on it to endpoints. **3:** Explore triangle centers: construct the centroid, orthocenter, and circumcenter. Show how these change with vertex dragging **4:**Plot $f(x) = ax^2 + bx + c$ and explore how a, b, and c affect shape and position using sliders. **5:** Input population data into a table and create a scatter plot. Fit a best-fit exponential model. **6:** Explore the function $f(x) = \sin(kx)$ and see the wavelength change dynamically with slider k. **7:** Plot $f(x) = \sin x$, graph its derivative, and draw tangent lines at key points using GeoGebra's tools. **8:** Shade the area under $f(x) = x^2$ from $x = 0$ to $x = 4$ using the integral feature. **9:** Show left, right, and midpoint Riemann sums for $f(x) = \sqrt{x}$ and compare with definite integral **10:** Create a compound interest model using $A = P(1 + r)^t$ with sliders for P, r, and t. **11:** Model a projectile motion path with parametric equations. Ani- mate the projectile over time. **12:** Create a 3D solid of revolution using a profile curve and rotate around an axis. Adjust input function and limits interactively	

Suggested Readings

1. Markus Hohenwarter et al., *GeoGebra Manual and Resources*, GeoGebra.org
2. Judith and Gary Kinsey, *Mathematics in Action Using GeoGebra*, Pearson

Assessment Rubrics

Evaluation Type	Marks
End Semester Evaluation (ESE)	**50 (35 T + 15 P)**
Continuous Evaluation (CCA)	**25 (15 T + 10 P)**
Theory (CCA)	**15**
(a) Test paper*	8
(b) Assignment	4
(c) Seminar/Viva-voce	3
Practical (CCA)	**10**
(a) Skill	6
(b) Record	4
Total	**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU5SECMAT301: LaTeX

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	SEC	300-399	KU5SECMAT301	2 + 1	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5

Course Description

This course provides students with a solid foundation in techniques and applications needed to handle LaTeX software for the preparation of articles or books.

Course Prerequisite

Higher Secondary Level Mathematics.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand basics of LaTeX	Understand
2	Learn document formatting in LaTeX through various examples	Apply
3	Learn creating Tables & Figures in LaTeX through various examples	Understand
4	Understand using Math Mode in LaTeX through various examples	Understand
5	Learn the content through practicing examples to create LaTeX	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2				✓			
CO 3	✓						
CO 4	✓						
CO 5				✓			

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Getting Started (Basics of LaTeX)**	11
	1	**Hello World** – Your first LaTeX document (article class) • Structure: \documentclass, \begin{document}, \end{document}	
	2	**Sections & Paragraphs** • Using \section, \subsection, \paragraph	
	3	**Text Formatting** • Bold, italics, underline, font sizes, color	
	4	**Lists** • **Itemize, enumerate, and description environments**	
	5	**Adding Comments & Packages** • **% for comments, \usepackage basics**	
		Document Formatting	
	1	**Title, Author, Date** • \title, \author, \date, and \maketitle	

II	2	**Page Layout & Margins** • Using geometry package to customize margins	**11**
	3	**Custom Headers & Footers** • Using fancyhdr to personalize page style	
	4	**Footnotes & Emphases** • Adding \footnote, \emph, custom commands	
	5	**Multicolumn Layout** • Using multicol package	

III	**Tables & Figures**		**12**
	1	**Basic Tables** • Using tabular environment	
	2	**Advanced Tables** • Merging cells with multirow, multicolumn, booktabs	
	3	**Inserting Images** • graphicx package, \includegraphics	
	4	**Figure Environments & Captions** • figure, \caption, \label, \ref	
	5	**Wrapping Text Around Images** • Using wrapfig package	
IV	**Math Mode**		**11**
	1	**Inline & Display Math** • \(... \), \[... \], equation environment	
	2	**Common Symbols** • Greek letters, sums, integrals, fractions	
	3	**Aligning Equations** • Using align and align* from amsmath	

	4	**Matrices** • bmatrix, pmatrix, using amsmath	
	5	**Theorems, Lemmas, and Proofs** • amsthm package and environments	
V		**Teacher Specific Module**	**15**
		Directions for Practicals: ***Students are required to submit output of at least 15 problems from following four modules.***	
		Module 1: Getting Started (Basics) **5. Hello World – Your first LaTeX document (article class** **6. Sections & Paragraphs** – Using \section, \subsection, \paragraph **7. Text Formatting – Bold, italics, underline, font sizes, color.** **8. Lists –** Itemize, enumerate, and description environments **5. Adding Comments & Packages** – % for comments, \usepackage	
		Module 2: Document Formatting **5. Title, Author, Date** – \title, \author, \date, \maketitle **6. Page Layout & Margins** – Using geometry package **7. Custom Headers & Footers** – Using fancyhdr **8. Footnotes & Emphases** – \footnote, \emph **5. Multicolumn Layout –** Using multicol package	
		Module 3: Tables & Figures **5. Basic Tables** – Using tabular environment **6. Advanced Tables –** Merging cells with multirow, multicolumn, booktabs **7. Inserting Images – graphicx package** **8. Figure Environments & Captions –** figure, \caption, \label **5. Wrapping Text Around Images** – Using wrapfig package	
		Module 4: Math Mode **5. Inline & Display Math** – $...$, \[...\], equation **6. Common Symbols –** Greek letters, sums, integrals, fractions	

		7. Aligning Equations – Using align and align* from amsmath **8. Matrices –** bmatrix, pmatrix **5. Theorems, Lemmas, and Proofs** – amsthm package	

Essential Readings

2. LaTeX - A Document Preparation System User's Guide and Reference Manual - Leslie Lamport. Digital Equipment Corporation, Addison-Wesley Publishing Company, Reading, Massachusetts Menlo Park, California.

Suggested Readings

1. Modern LATEX, Matt Kline, Second edition (online pdf), typeset October 25, 2022.
2. The Not So Short Introduction to LATEX (or LATEX in 280 minutes), Tobias Oetiker, Marcin Serwin Hubert Partl, Irene Hyna, and Elisabeth Schlegl.
3. A Short Introduction to LaTeX, A book for beginners, Firuza Karmali (Aibara)
4. B.N. Gupta, Business Mathematics and Statistics, SBPD Publications, 2021
5. Knut Sydestar and Peter Hummond with Arne Storm, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson.

Assessment Rubrics

Evaluation Type	Marks
End Semester Evaluation (ESE)	**50 (35 T + 15 P)**
Continuous Evaluation (CCA)	**25 (15 T + 10 P)**
Theory (CCA)	**15**
(a) Test paper*	8
(b) Assignment	4
(c) Seminar/Viva-voce	3
Practical (CCA)	**10**
(a) Skill	6
(b) Record	4
Total	**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU6SECMAT301: SCILAB

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	SEC	300-399	KU6SECMAT301	2 + 1	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2		25	50	75	1.5

Course Description

This course introduces students to the fundamentals of **SciLab**, a powerful open-source platform for numerical computations and mathematical modeling. The course emphasizes hands-on learning and applies SciLab to visualize and solve real-world mathematical problems.

Course Prerequisite

Higher Secondary Level Mathematics.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
CO1	Understand SciLab interface, environment, and basic syntax	Understand
CO2	Apply SciLab commands for basic arithmetic and logical operations	Apply
CO3	Plot 2D and 3D graphs and visualize mathematical functions using SciLab	Apply
CO4	Solve algebraic and matrix problems using SciLab functions	Apply
CO5	Practice mathematical modeling and simple simulations through SciLab scripting	Create

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					✓		
CO 2						✓	
CO 3					✓		
CO 4		✓					
CO 5			✓				

MODULE	UNIT	DESCRIPTION	HOURS (for theory)
I		**Introduction to SciLab**	7
	1	**Introduction to SciLab software:** Overview of SciLab as an open-source computational platform for mathematical modeling and numerical computation.	
	2	**Installation and software environment:** Installing SciLab and exploring the SciLab interface, command window, editor, and variable browser.	
	3	**Operators and expressions:** Using arithmetic, relational, logical, and trigonometric operations in SciLab.	
	4	**Vectors and matrices:** Creating and manipulating row/column vectors and matrices; performing element-wise and matrix operations.	
II		**Control Structures and Programming**	8
	1	**Conditional statements:** Using if, else, and elseif to perform conditional checks in SciLab scripts.	
	2	**Loops:** Applying for and while loops to automate repetitive tasks; examples on factorial and summation.	
	3	**Input/output functions:** Using input(), disp(), printf(), and write () to interact with users and display results.	
	4	**User-defined functions:** Writing functions for tasks such as: Addition of two numbers Square of a number Checking even or odd Calculating the area of a circle	

III	**Graphics and Visualization**		8
	1	**2D Plotting:** Using plot, xlabel, ylabel, title, and legend to display functions like y = sin(x), etc.	
	2	**3D Plotting:** Creating 3D surfaces using plot3d, contour, and surf for functions like $z = x^2 + y^2$.	
	3	**Multiple plots and customization:** Generating comparative plots such as: Multiple function plots (sine, cosine) Bode plots (using control system toolbox) Pie charts and bar charts for data representation	
IV	**Mathematical Computations in SciLab**		7
	1	**Solving algebraic equations:** Using built-in SciLab functions (e.g., solve(), roots()) for solving equations and polynomials.	
	2	**Matrix operations:** Performing tasks such as addition, multiplication, transposition, inversion, and solving linear systems using \ operator.	

Teacher specific module

Practical Work: Sample Programmes

Practical Component (30 Hours)

Students are required to perform and submit outputs of at least 12 practical problems, covering:

- Basic SciLab scripting
- Visualizing mathematical functions
- Algebraic manipulations and matrix operations
- Graphical simulations and curve fitting
- Simple numerical methods (e.g., root finding, numerical integration)

Module I: Introduction to SciLab

1. Basic Arithmetic and Variable Assignment

2. Creating Vectors and Matrices

3. Calculate Area of Circle

Module II: Control Structures and Programming

4. Using Conditional Statement (if-else)

5. Using Loops to Calculate Factorial

6. Creating a Function to Find Maximum of Two Numbers

7. Input/output functions

8. User-defined functions

Module III: Graphics and Visualization

9. Plotting a 2D Graph of y = sin(x)

10. Plotting a 3D Surface (z = x^2 + y^2)

11. Plotting Multiple Functions on Same Graph

Module IV: Mathematical Computations

12. Finding Roots of a Polynomial

13. Matrix Addition (3×3)

14. Matrix Multiplication (3×3)

15. Determinant of a 3×3 Matrix

Essential Readings

1. Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists. Apress publisher, New York,USA, 2017.
2. A.S.Nair, SCILAB (A free software to MATLAB), S. Chand Publishing, New Delhi, India, 2012.
3. SciLab – A Free Software to Learn Numerical Methods, Scilab Enterprises.
4. Basic Scilab Manual, FOSSEE, IIT Bombay.
5. Scilab: A Free Software to Learn Numerical Computation – Scilab.in

Suggested Readings

1. https://www.scilab.org/
2. https://onlinecourses.swayam2.ac.in/aic20_sp38/preview
3. https://www.udemy.com/course/scilab-the-first-course-beginners-to-intermediate/mediate/
4. Introduction to Scilab – A Beginner's Approach by S.N. Sivanandam.
5. Computational Methods using Scilab – M. Affouf.
6. Numerical Methods for Engineers – Steven C. Chapra, Raymond P. Canale.

Assessment Rubrics

3 Credit Course (2 credit theory + 1 credit practical)

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory			**50**	**Practical**			**25**	**75**
a)	**ESE**		**35**	a)	**ESE**		**15**	
b)	**CCA**		**15**	b)	**CCA**		**10**	
	i	*Test Paper	8		i	Punctuality	2	
	ii	Assignment	4		ii	Skill	5	
	iii	Seminar/ Viva-Voce	3		iii	Record	3	

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.

KU6SECMAT302: PROGRAMMING IN PYTHON

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	SEC	300-399	KU6SECMAT302	2+1	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5

Course Description

This course provides an introduction to programming using the Python language, one of the most popular and versatile programming languages today.

Course Prerequisite

Basic computer literacy.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Apply Core Python Syntax and Semantics	Apply
2	Use Data Types and Variables Effectively	Apply
3	Use conditional statements to control the flow of programs	Apply
4	Develop and use functions and modules	Apply

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓				✓		
CO 2	✓				✓		
CO 3	✓				✓		
CO 4	✓				✓		

COURSE CONTENTS

Contents for Classroom Transaction

<table>
<tr><th>MODULE</th><th>UNIT</th><th>DESCRIPTION</th><th>HOURS</th></tr>
<tr><td rowspan="2">I</td><td colspan="2">Introduction to Python</td><td rowspan="2">7</td></tr>
<tr><td>1</td><td>(a) Features of Python
(b) Variables
(c) Indentation in Python
(d) Input, Output and Import Functions
(e) Operators
(Sections 1.1, 1.5, 1.7, 1.11, 1.12 of Essential Readings 1) (1.12.4 and 1.12.7 omitted)</td></tr>
<tr><td rowspan="2">II</td><td colspan="2">Data types and Operations</td><td rowspan="2">8</td></tr>
<tr><td>1</td><td>(a) Numbers
(b) List
(c) Tuples
(d) Set
(e) Dictionaries
(Sections 2.1, 2.3, 2.5, 2.6 of Essential Readings 1).</td></tr>
<tr><td rowspan="2">III</td><td colspan="2">Flow Control</td><td rowspan="2">8</td></tr>
<tr><td></td><td>(a) Decision making
(b) Loops
(c) Nested Loops
(d) Control Statements
(Section 3.1, 3.2, 3.3, 3.4 of Essential Readings 1).</td></tr>
<tr><td rowspan="2">IV</td><td colspan="2">Data visualization</td><td rowspan="2">7</td></tr>
<tr><td></td><td>(a) The Matplot lib Module
(b) Plotting mathematical functions, Famous Curves
(c) 2D plot using colors
(Relevant sections from Essential Readings 2).</td></tr>
</table>

V	**Teacher Specific Module** *Directions for Practicals* **Programmes** 1. Solution of Ax =B using Doolittle method 2. Newton-Raphson's Method 3. Bisection Method 4. Method of false position 5. Trapezoidal rule of Numerical Integration 6. Simpson's Three Eighth rule of Numerical Integration 7. Euler's Modified Method to solve first order differential equation 8. Runge-Kutta Method of Order 4 9. Lagrange's Method for Interpolation 10.Taylor Series Method for initial value problems.	**30**

Essential Readings

1. Dr. Jeeva Jose, Taming Python by Programming, Khanna Publications
2. B.P. Ajith Kumar, Python for Education – Learning Mathematics and Physics using Python and writing them in Latex (Free download from www.iuac.res.in/phoenix).

Suggested Readings

1. J. Kiusalaas, Numerical methods in Engineering with Python, Cambridge University Press.

Assessment Rubrics

Evaluation Type	Marks
End Semester Evaluation (ESE)	**50 (35 T + 15 P)**
Continuous Evaluation (CCA)	**25 (15 T + 10 P)**
Theory (CCA)	**15**
(a) Test paper*	8
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(c) Seminar/Viva-voce	3
Practical (CCA)	**10**
(a) Skill	6
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Total	**75**

* A student has to appear for at least two written tests. Average mark of best two tests is to be considered for internal mark.