KANNUR UNIVERSITY

(Abstract)

First and Second Semester Scheme and Syllabus of B.Sc. Computational Mathematics Honours/Honours with Research Programme in tune with KU-FYUGP Regulations 2024 with effect from 2024 Admission onwards- Approved- Implemented- Orders Issued

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FYUGP Spl.cell

ACAD/FYSC-III/21052/2024 Dated: 19.10.2024

Read:-1. U.O. No. FYUGPSC/FYSC-I/5074/2024, dated: 18/04/2024

2. E-mail of the Chairperson, Board of Studies in Mathematics(UG), on 19.06.2024

3.The Minutes of the Meeting of the Scrutiny Committee held on 21.06.2024

4. E-mail of the Chairperson, Board of Studies in Mathematics(UG), on 24.06.2024

5.The Orders of the Vice Chancellor dtd 24.06.2024

6. The Minutes of the Meeting of the Academic Council, held on 25.06.2024

ORDER

1.The Regulations of the Kannur University Four Year UG Programmes (KU-FYUGP Regulations 2024) for affiliated Colleges was implemented with effect from 2024 admission onwards, vide paper read as (1) above.

2.Subsequently, the Chairperson, Board of Studies in Mathematics(UG) vide paper read as (2) above, submitted the Syllabus of the B.Sc. Computational Mathematics Honours/Honours with Research programme for the first and second semesters in tune with KUFYUGP Regulations 2024 with effect from 2024 admission onwards.

3.Thereafter, the Scrutiny Committee, which included the Dean, Faculty of Science vide paper read as (3) above, scrutinized the Syllabus and recommended suggestions.

4.Subsequently, vide paper read as (4) above, the Chairperson, Board of Studies in Mathematics(UG) forwarded the modified Syllabus of the B.Sc.Computational Mathematics Honours/Honours with Research programme for first and second semesters for approval.

5.Thereafter, the Vice Chancellor ordered to place the same before the Academic Council for consideration, as per the paper read (5) above.

6. Accordingly, the Syllabus of the B.Sc. Computational Mathematics Honours/Honours with Research programme for first and second semesters in tune with KU-FYUGP Regulations 2024 was approved by the meeting of the Academic Council held on 25-06-2024 and granted permission to publish the same, as and when it is ready, after making the necessary modifications, as per paper read as (6) above.

7.Considering the matter in detail, the Vice Chancellor approved the Minutes of the aforesaid meeting of the Academic Council and the Syllabus of the B.Sc.Computational Mathematics Honours/Honours with Research programme for the First and Second Semesters, prepared in tune with KU-FYUGP Regulations, 2024.

8.The approved Syllabus of I and II Semester B.Sc. Computational Mathematics Honours/Honours with Research programme is appended with this U.O. and uploaded in the University website.

Orders are issued accordingly.

Sd/-

ANIL CHANDRAN R

DEPUTY REGISTRAR (ACADEMIC)

For REGISTRAR

To: The Principals of Arts and Science Colleges affiliated to Kannur University

Copy To: 1. The Examination Branch (through PA to CE)
2. The Chairperson, Board of Studies in Mathematics(UG)
3. PS to VC/PA to R
4. DR/AR (Academic)
5. The IT Cell (For uploading in the website)
6. SF/DF/FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY

FOUR YEAR UNDERGRADUATE PROGRAMME

SYLLABUS

COMPUTATIONAL 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 self-directed 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, Artificial Intelligence, Data Science and more, which are necessary to instill 21st 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 **Computational 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, and applications of these concepts in Computer Science.

PSO 2: Develop abstract reasoning and critical thinking skills necessary for advanced mathematical study and applications in various fields like Artificial Intelligence, Data Science, Machine Learning etc.

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 software 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

COMPUTATIONAL MATHEMATICS HONOURS/

HONOURS WITH RESEARCH PROGRAMME STRUCTURE

B.Sc. Computational Mathematics Pathway Courses (2024 admission onwards)						
Sl. No.	***Level***	***Course Code***	***Semester***	***Name of course***	***Credits***	***Major Pathway Courses***
1	100-199	KU1DSCCMT101	I	COMPUTATIONAL CALCULUS-1	4	1
2	100-199	KU1DSCCMT111	I	FUNDAMENTALS OF MATHEMATICS	4	
3	100-199	KU1DSCMT112	I	MATHEMATICAL STATISTICS 1	4	
4	100-199	KU2DSCCMT101	II	COMPUTATIONAL CALCULUS-2	4	2
5	100-199	KU2DSCCMT111	II	BASIC COMPUTATIONAL MATHMATICS	4	
6	100-199	KU2DSCMT112	II	MATHEMATICAL STAISTICS II	4	
7	200-299	KU3DSCCMT201	III	INTRODUCTION TO GEOMETRY AND ANALYSIS	4	3
8	200-299	KU3DSCCMT202	III	ORDINARY DIFFERENTIAL EQUATIONS	4	4
9	200-299	KU3DSCCMT211	III	ADVANCED PROBABILITY THEORY	4	
10	200-299	KU3DSCCMT212	III	GRAPH THEORY	4	
11	200-299	KU4DSCCMT201	IV	REAL ANALYSIS - I	4	5
12	200-299	KU4DSCCMT202	IV	MULTI VARIABLE CALCULUS	4	6
13	200-299	KU4DSCCMT203	IV	INTRODUCTION TO ABSTRACT ALGEBRA	4	7
14	300-399	KU5DSCCMT301	V	REAL ANALYSIS - II	4	8
15	300-399	KU5DSCCMT302	V	FIELD THEORY AND LINEAR ALGEBRA	4	9
16	300-399	KU5DSCCMT303	V	VECTOR CALCULUS	4	10
17	300-399	KU5DSECMT301	V	SCILAB	4	11/12 Elective (a)
18	300-399	KU5DSECMT302	V	OPERATIONS RESEARCH	4	11/12 Elective (b)

19	300-399	KU5DSECMT303	V	MATHEMATICAL FINANCE	4	11/12 Elective (c)
20	300-399	KU5DSECMT304	V	FUZZY SET THEORY	4	11/12 Elective (d)
21	300-399	KU6DSCCMT301	VI	COMPLEX ANALYSIS	4	13
22	300-399	KU6DSCCMT302	VI	LINEAR ALGEBRA FOR MACHINE LEARNING	4	14
23	300-399	KU6DSCCMT303	VI	LAPLACE TRANSFORMS, FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS	4	15
24	300-399	KU6DSECMT301	VI	NUMBER THEORY AND CRYPTOGRAPHY	4	16/17 Elective (a)
25	300-399	KU6DSECMT302	VI	ADVANCED ANALYSIS	4	16/17 Elective (b)
26	300-399	KU6DSECMT303	VI		4	16/17 Elective (c)
27	300-399	KU6DSECMT304	VI		4	16/17 Elective (d)
28	300-399	KU6DSECMT303	VI		4	16/17 Elective (d)
29		KU6INTCMT301	VI	Internship/Apprenticeship/Field Trip	2	18
30	400-499	KU7DSCCMT401	VII		4	19
31	400-499	KU7DSCCMT402	VII		4	20
32	400-499	KU7DSCCMT403	VII		4	21
33	400-499	KU7DSCCMT404	VII		4	22
34	400-499	KU7DSCCMT401	VII		4	23
35	400-499	KU8DSCCMT401	VIII		4	24
36	400-499	KU8DSCCMT402	VIII		4	25
37	400-499	KU8DSCCMT403	VIII		4	26
38	400-499	KU8DSECMT401	VIII	Research Methodology in Computational Mathematics	4	27/28/29 Elective (a)
39	400-499	KU8DSECMT402	VIII		4	27/28/29 Elective (b)
40	400-499	KU8DSECMT403	VIII		4	27/28/29 Elective (c)
41	400-499	KU8DSECMT404	VIII	MOOC/Online course I	4	27/28/29 Elective (d)
42	400-499	KU8DSECMT405	VIII	MOOC/Online course II	4	27/28/29 Elective (e)
43	400-499	KU8DSECMT406	VIII	MOOC/Online course III	4	27/28/29 Elective (f)
44	400-499	KU8CIPCMT 400	VIII	Capstone Internship Project in Honours Programme in Computational Mathematics	8	30(a)

45	400-499	KU8PHRCMT400	VIII	Project in Honours with Research Programme in Mathematics	12	30(b)

General Foundation Courses offered by Department of Mathematics

Sl. No.	*Level*	*Course Category*	*Course Code*	*Semester*	*Name of Course*	*Credits*
1	100-199	MDC	KU1MDCCMT101	I	LOGIC, LATTICES AND BOOLEAN ALGEBRA	3
2	100-199	MDC	KU2MDCCMT101	II	NUMERICAL ABILITY	3
6	200-299	VAC	KU3VACCMT201	III	COMPUTATIONAL MATHEMATICS - I	3
7	200-299	VAC	KU3VACCMT202	III		3
8	200-299	VAC	KU4VACCMT201	IV		3
9	200-299	VAC	KU4VACCMT202	IV		3
10	200-299	VAC	KU4VACCMT203	IV		3
11	200-299	VAC	KU4VACCMT204	IV		3
12	200-299	SEC	KU4SECMAT201	IV		3
13	200-299	SEC	KU4SECMAT202	IV		3
14	300-399	SEC	KU5SECCMT301	V		3
15	300-399	SEC	KU5SECCMT302	V		3
16	300-399	SEC	KU5SECCMT303	V		3
17	300-399	SEC	KU6SECCMT301	VI		3
18	300-399	SEC	KU6SECCMT302	VI		3
19	300-399	SEC	KU6SECCMT303	VI		3

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	Totalmarks
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	Totalmarks
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	Totalmarks
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

	Total Credit	Total Marksfor CE	Total Marks for ESE	Total marks
Project and Courses as perthe FYUGP Regulation	24	180	420	600

DISCIPLINE SPECIFIC COURSES

KU1DSCCMT101: COMPUTATIONAL CALCULUS-1

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCCMT101	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, optimization problem, antiderivatives and to discuss applications of differentiation.

Course Prerequisite

Functions

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend exponential functions, inverse functions, logarithmic function and hyperbolic functions	Understand
2	Understand the notion of limit and limit laws	Understand
3	Understand continuity of a function	Understand
4	Comprehend the notion of derivative of a function and differentiation rules	Understand
5	Understand indeterminate forms	Understand
6	Understand the effect of derivative on the shape of graph of a function	Apply
7	Comprehend the antiderivatives	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**		12
	1	**Functions**	
		a) Exponential functions	
		b) Inverse functions	
		c) Logarithmic functions	
	2	**Limits**	
		a) Limit of a function and limit laws	
		b) Continuity	
		c) Horizontal Asymptotes	
II	**Differentiation of functions and Extreme values of a function**		12
	1	Derivatives and rate of change	
	2	Hyperbolic functions	
	3	Extreme values of a function	
		Maximum values	

		Minimum values	
		The Mean Value Theorem	
III	**Application of derivatives**		12
	1	Shape of graph of a function	
	2	Indeterminate forms	
		a) L 'Hospital rule	
IV	**Optimization problems and antiderivatives**		12
	1	Optimization problems	
	2	Antiderivatives	
V	**Teacher Specific Module**		12
	Directions		
	Summary of curve sketching, graphing with calculus and calculator (Sections 4.5 to 4.6), Illustration of the topic in module I to module IV using software like GeoGebra, Desmos Calculator etc.		

Essential Readings:

1. James Stewart Calculus; Early Transcendentals, 9th Edition, Cengage Learning 2021

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 1.4, 1.5	
	2	1	Section 2.2 ,2.3, 2.5, 2.6	
II	1	1	Section 2.7, 3.11	
	2	1	Sections 4.1, 4.2	
III	1	1	Section 4.3	
	2	1	Sections 4.4	
IV	1	1	Sections 4 .7, 4.9	

Suggested Readings:

1. B.S. Grewal, Higher Engineering Mathematics, (43rd edition), Khanna Publishers
2. G.B. Thomas Jr., M.D. Weir and J.R. Hass, Thomas' Calculus: Early Transcendentals (12th edition), Pearson Education.
3. H. Anton, I. Bivens and S. Davis, Calculus, 10th edition , Willey

4. S. Narayan and P.K. Mittal, Integral calculus, Revised Edition, S. Chand & Company Ltd.
5. 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.

KU1DSCCMT111: FUNDAMENTALS OF MATHEMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCCMT111	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	Apply
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**		**12**
	1	Relations on sets	
	2	Types of relations	
	3	Equivalence relations	
	4	Equivalence classes and partitions of a set	
II	**Induction Principles**		**12**
	1	The Induction Principle	
	2	The Strong Induction Principle	
	3	The Well-ordering Principle	
	4	Equivalence of the three principles	
III	**Countability of Sets**		**12**
	1	Sets with same cardinality	
	2	Finite sets	
	3	Countable sets	
	4	Comparing cardinality	
IV	**Order Relations**		12
	1	Partial and Total Orders	
	2	Chains, bounds and maximal elements	
	3	Axiom of Choice and its Equivalents	
V	**Teacher Specific Module**		**12**
	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

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.

KU1DSCCMT112: MATHEMATICAL STAISTICS 1

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCCMT112	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 elementary introduction to probability and statistics with applications. Topics include random variables, probability distribution *Functions,* Mathematical Expectations, Joint Probability Law and Covariance

Course Prerequisite

Set Theory, Multy-Variable calculus

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend Basic concepts in Probability	Understand
2	Understand continuous and Discrete Distribution Functions	Understand
3	Understand the Expected value of a Random Variable	Understand
4	Bivariate random variables and joint probability Law	Understand
5	Understand Covariance between two Random variables	Understand
6	Understand Jenson's Inequality	Understand
7	Use software and simulation to do statistics (R)	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		**Basic concepts in Probability**	**12**
	1	a)Random Variables	
		b)Distribution Functions	
	2	a)Discrete Random Variables and Examples	
II		**Continuous Random Variables and Bivariate Distribution**	**12**
	1	a) Continuous Random Variables and Examples	
	2	a) Joint Probability Law	
III		**Combination of random variables and it's pdf**	**12**
	1	**a)** Transformation of one dimensional Random variables	
		b) Mathematical Expectation	
	2	a)Expectation of a function of Random Variables	
		b)Addition Theorem of Expectation	
		c)Multiplication Theorem of Expectation	
IV		**Expectation ,Covarience and Jenson's Inequality**	**12**
	1	a)Expectations of a linear combination of Random Variables	
		b)Covariance	
	2	a)Jenson's inequality	
V		**Teacher Specific Module**	**12**
		Directions	
		R programming	

Essential Readings:

1. S C Gupta & V K Kapoor; Fundamentals of Mathematical Statistics (10 th revised edition);

S Chand and Sons; 2002

2. Peter Dalgard; Introductory Statistics with R; Springer (2008)

Module	Unit	Reference 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 omitted
	2	1	Sections 5.5	
III	1	1	Section 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

Suggested Readings:

1. Dennis Wackerly, William Mendenhall Ill and Richard S, Mathematical Statistis 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.**

KU2DSCCMT101: COMPUTATIONAL CALCULUS-2

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU2DSCCMT101	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

In this course the student will learn the definite integral of a function, techniques to evaluate trigonometric integrals, and applications of integration. Also to approximate the value of a definite integral using the different methods of numerical integration.

Course Prerequisite

Integrals of basic functions and rules of integration

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamental theorem of calculus and apply it to find the derivatives and integrals of certain functions.	Understand
2	Apply the notion of definite integrals to find area between curves, volumes using cross-sections, arc length and areas of surfaces of revolution	Apply
3	Understand integration by successive reduction and apply reduction formulas to evaluate trigonometric integrals	Understand
4	Understand the concept of polar coordinates and apply it to find areas under the curves and length of curves	Apply
5	Understand numerical integration and apply the different numerical integration methods to approximate the value of a definite integral.	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		**Integrals and it's applications**	12
	1	a)The Definite integral,	
		b) The Fundamental theorem of Calculus,	
		c) Indefinite integrals and the Net change theorem	
	2	**Application of Integration**	
		a) Area between curves	
II		**Application of Integration ,Reduction formulas and trigonometric Integrals**	12
	1	**Applications of Integration**	
		a) Volumes,	
		b) Volumes by cylindrical shells	
		c) Work	
		d) Average value of a function,	
	2	**Reduction formulas and trigonometric Integrals**	
		a) Reduction formulas and corresponding problems (From the exercise only)	
		b) Trigonometric integrals	

III	**Further applications of integration, Polar Co-ordinates**		**12**
	1	**Applications of integration**	
		a) Arc length	
		b) Area of a surface of revolution	
	2	**Polar Coordinates**	
		a) Polar Coordinates	
		b) Areas and Lengths in Polar Coordinates	
IV	**Numerical Integrations.**		**12**
	1	a) Numerical Integration,	
		b) Left End Points, Right End Points and Midpoint Sums	
		c) Trapezoidal Sums	
		d) Simpson's Rule	
		e) Gaussian Quadrature	
V	**Additional Topic offered by teacher**		**12**
	Directions		
	Discuss the geometry of problems solved in Unit I to Unit III using various software like Geogebra, Desmos Calculator etc.		
	Relevant Problems in Unit IV from the reference books to be discussed		

Essential Readings:

1. James Stewart, Daniel Clegg, Saleem Watson; Calculus Early Transcedentals - Metric version; 9th Edition; Cengage Learning 2021.

2. William C. Bauldry; Introduction to computational Mathematics; First edition; CRC Press.

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 5.2, 5.3, 5.4	
	2	1	Section 6.1	
II	1	1	Section 6.2, 6.3, 6.4, 6.5	
	2	1	Sections 7.1, 7.2	*Only reduction formulas from section7.1 and it's excercises*
III	1	1	Sections 8.1, 8.2	
	2	1	Sections 10.3, 10.4	

IV	1	2	sections 1, 2, 3, 4, 5 from Chapter V	

Suggested Readings:

1. H. Anton, I. Bivens and S. Davis; Calculus; 10th edition; Willey
2. G.B Thomas Jr., M.D Weir and Joel R.Hass; Thomas' Calculus(12th edition); Pearson,2009
3. S.K Stein; Calculus and Analytic Geometry; McGraw Hill, 1992.
4. G.F Simmons; Calculus with analytic Geometry (second edition); McGraw Hill,1995.
5. S.S Sastry; Introductory methods of numerical analysis; Fifth edition; PHI
6. M.K Jain, S.R.K. Iyengar, R.K. Jain; Numerical Methods For Scientific And Engineering Computation (4th Edition); New Age International Publications.

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.

KU2DSCCMT111: BASIC COMPUTATIONAL MATHEMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCCMT111	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.	Understand, 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	✓						
CO 6	✓						
CO 7	✓						

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	**Set Theory**		**12**
	1	a) Basic Definitions b) Operations on Sets. c) Principle of Inclusion -Exclusion.	
II	**Functions**		**12**
	1	a) Basic Definitions. b) Operations on Functions c) Pigeon hole Principle.	
III	**Comparing Growth Rates of Functions**		**12**
	1	a) A Measure for Comparing Growth Rates b) Properties of Asymptotic Domination. c) Polynomial Functions d) Exponential and Logarithmic Functions	
IV	**Recurrence Relations**		**12**
	1	a) The Tower of Hanoi Problem. b) Solving First - Order Recurrence Relations. c) Fibonacci Recurrence Relation.	
V	**Teacher Specific Module**		**12**
	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	Essential Reading 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	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.

KU2DSCCMT112: MATHEMATICAL STATISTICS 2

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	DSC	100-199	KU2DSCCMT111	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 MGF, Cumulants, Chebychev's Inequality and Different types of Discrete and Continuous distributions,

Course Prerequisite

Integral and differential Calculus

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand M.G.F	Understand
2	Understand Discrete Distribution	Understand
3	Understand Continuous distributions	Understand
4	Apply discrete distribution to solve real life problems	Apply
5	Apply Continuous distribution to solve real life problems	Apply
6	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	✓		✓		✓		✓

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	MGF, Cumulants and Chebychev's Inequality		
	1	a)Moment generating functions	12
		b) Cumulants	
	2	a)Chebychev's Inequality	
II	**Discrete distributions part I**		
	1	**a)** Bernoulli's distribution	12
	2	a) Binomial distribution	
III	**Discrete distributions part II**		12
	1	a)Poisson distribution	
	2	a)Geometric distribution	
IV	Continuous Distributions and Central Limit Theorem.		12
	1	a)Rectangular Distribution	
		b)Normal Distribution	
	2	a) Central Limit Theorem	
V	**Teacher Specific Module**		12
	Directions		
	R programming		

Essential Readings:

1. S C Gupta, V K Kapoor; Fundamentals of Mathematical Statistics (10th revised edition); S Chand and Sons; 2002

2. Peter Dalgard; Introductory Statistics with R; Springer (2008)

Module	Unit	Essential Reading 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) Sections8.2.9, 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 and 8.10.4 are omitted
V	1	2	Relevant sections	

Suggested Readings:

1. Dennis Wackerly, William Mendenhall Ill and Richard S; Mathematical Statistics with Application (Seventh Edition); Duxbury Press; 2007
2. Robert. V. Hogg, 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.**

KU3DSCCMT201: INTRODUCTION TO GEOMETRY AND ANALYSIS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCCMT201	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 sequences and series, convergence tests of sequences and series in analysis and different coordinate systems such as polar coordinate system, cylindrical coordinate system, spherical coordinate system and sketching of cylinders and quadratic surfaces in analytic geometry.

Course Prerequisite

Elementary calculus including Functions, limits, integrals and geometric concepts including Cartesian coordinate system, lines, planes, conics.

Course Outcomes

CO No	Expected Outcome	Learning Domains
1	Understand sequences, series and their convergence and divergence.	Understand
2	Apply convergence tests to sequences and series to test convergence	Apply
3	Understand the polar coordinate system and the relation between polar and cartesian coordinate system	Understand
4	Understand Cylindrical coordinate system and spherical coordinate system .	Understand
5	Understand the cylinders and quadratic surfaces	Understand
6	Identify the cylindrical surfaces and quadratic surfaces.	Understand
7	Sketch the graph of cylinders and quadratic surfaces	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		**Sequences and series**	12
	1	Sequences	
		a) Infinite sequences	
		b) The limit of a sequences	
		c) Properties of convergent sequences	
		d) Monotonic and bounded sequences	
	2	**Series**	
		a) Infinite series	
		b) Geometric series	
		c) Test for divergence	
		d) Properties of convergent series	
		e) Integrals Test and estimates of sum	
		f) The direct comparison test and Limit comparison test	
II		**Alternating series, Absolute Convergence and Convergence tests for series**	12
		Alternating series and Absolute convergence	

	1	a) Alternating series	
		b) Estimating sum of Alternating series	
		c) Absolute convergence and conditional convergence	
		d) Rearrangements	
	2	a) Ratio and Root tests	
	3	a) Strategy for testing series	
III	**Coordinate systems**		**12**
	1	**Polar coordinates**	
		a) Polar coordinate system	
		b) Relationship between Polar and Cartesian coordinates	
	2	**Cylindrical coordinates and Spherical coordinates**	
		a) Cylindrical coordinates	
		b) Spherical coordinates	
IV	**Cylinders and Quadratic surfaces**		12
	1	a) Cylinders	
	2	a) Quadratic surfaces	
		b) Application of quadratic surfaces	
V	**Teacher Specific Module**		**12**
	Polar curves, Symmetry of polar curves, Conics sections in polar curves, Polar equations of conics.		

Essential Readings:

1. G.B. Thomas Jr., M.D. Weir and J.R. Hass; Thomas' Calculus: Early Transcendentals (12^{th} edition); Pearson Education
2. H. Anton, I. Bivens and S. Davis; Calculus (Tenth Edition); John Wiley & Sons Inc; 2012.

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Section 11.1	Proof Omitted
	2	1	Sections 11.2, 11.3, 11.4	Proof Omitted
II	1	1	Section 11.5	Proof Omitted
	2	1	Section 11.6	Proof Omitted

	3	1	Section 11.7	Proof Omitted
III	1	1	Section 10.3	Polar Curves excluded
	2	1	Sections 15.7, 15.8	Relevant topics only
IV	1	1	Section 12.6	
V		2	Relevant topics	TSM

Suggested Readings

1. S.K. Stein; Calculus and Analytic Geometry; McGraw Hill; 1992.
2. G.F. Simmons; Calculus with Analytic Geometry (Second Edition); McGraw Hill; 1995.
3. Richard A Silverman , Modern Calculus and Analytic Geometry, Dover Publications Inc
4. Earl Swokowski; Calculus with Analytic Geometry; Second edition; Brooks/ Cole

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.

KU3DSCCMT202: ORDINARY DIFFERENTIAL EQUATIONS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCCMT202	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 concepts of ordinary differential equations, modelling, different methods to solve first order ODE and second order ODE.

Course Prerequisite

Differentiation, Integration

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the basic concepts of ordinary differential equations	Understand
2	Understand Modelling	Apply
3	Understand various methods to solve first order ODE	Understand
4	Understand various methods to solve second order ODE	Understand
5	Comprehend the concepts of existence and uniqueness of solution of an initial value problem	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	**First order Ordinary Differential Equations**		**12**
	1	**Basic concepts of first order ODE**	
		a)Basic concepts	
		b) Modelling	
	2	**Methods of solving first order ODE**	
		a) Separable ODEs; modelling	
		b) Exact ODEs	
		c) Integrating factors	
		d) Linear ODEs	
II	**First order Ordinary Differential Equations**		**12**
	1	a) Bernoulli equation	
		b) Population dynamics	
		c) Orthogonal trajectories	
	2	Existence and uniqueness of solutions	
III	**Second order Ordinary Differential Equations**		**12**
	1	a) Homogeneous linear ODEs of second order	
		b) Homogeneous linear ODEs with constant coefficients	
	2	a) Differential operators	
		b) Euler-Cauchy equations	

IV	**Second order Ordinary Differential Equations**		**12**
	1	a) Existence and uniqueness of solutions (Proof omitted)	
		b) Wronskian	
		c) Nonhomogeneous ODEs	
		d) Solution by Variation of Parameters	
V	**Teacher Specific Module**		**12**
	Directions		
	Discuss and visualize the solutions of ODE using various softwares like Geogebra, Scilab, Python etc.		

Essential Readings:

1. Erwin Kreyzig; Advanced Engineering Mathematics (Tenth Edition); John Wiley & Sons.

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Section 1.1	
	2	1	Section 1.3 to 1.5	
II	1	1	Section 1.5 to 1.6	
	2	1	Sections 1.7	Proof omitted
III	1	1	Sections 2.1, 2.2	
	2	1	Sections 2.3, 25	
IV	1	1	Sections 2.6	Proof omitted
	2	1	Sections 2.7, 2.10	

Suggested Readings:

1. S.L.Ross; Differential Equations (Third Edition); Wiley & Sons; 1984.
2. A.H.Siddiqi & P.Manchanda; A First Course in Differential Equations with Applications; Macmillan, 2006.
3. E.A. Coddington; An Introduction to Ordinary Differential Equation; PHI; 2009.

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.

KU3DSCCMT211: ADVANCED PROBABILITY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCCMT211	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 Sampling, Null Hypothesis, Level of Significance, critical region, Standard Error and Chisquare distribution and also testing Hypothesis using Normal and Chisquare distribution.

Course Prerequisite

Integration.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand Sampling and Types of Sampling	Understand
2	Understand Null Hypothesis	Understand
3	Understand Error in statistic	Understand
4	Understand Critical region	Understand
5	Understand level of significance	Understand
6	Testing of Hypothesis	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		**sampling and Testing of Hypothesis for large samples**	12
	1	a) Sampling and Types of Sampling	
	2	a) Testing of Hypothesis for large samples	
II		**Test for single proportion and Unbiased Estimate**	12
	1	a) Test for single proportion	
	2	a) Unbiased Estimate for population mean	
		b) Unbiased Estimate for Population Variance	
III	.	**Standard error of Sample mean Test of significance for mean and difference of Standard deviation**	**12**
	1	a) Standard error of Sample mean	
		b) Test of significance for mean	
		c) Test of significance for difference of means	
	2	a) Test of significance for difference of Standard deviations	
IV		**Chisquare distribution and Applications Chisquare distribution**	12
	1	a) Chisquare distribution	
		b) Applications of Chisquare distribution	
	2	a) Yates correction	
V		**Teacher Specific Module**	12
		Directions	
		R programming	

Essential Readings:

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

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 12.1, 12.2	
	2	1	Sections 12.3 to 12.8	
II	1	1	Section 12.9	Section 12.9.1 omitted
	2	1	Sections 12.10, 12.11	
III	1	1	Sections 12.12 to 12.14	
	2	1	Sections 12.15	

IV	1	1	Sections 13.1,13.2, 13.3, 13.7	Sections 13.3.3 and 13.3.4 are omitted
	2	1	Section 13.8	
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. (De Gruyter STEM) Frank S Emmert-Streib, Salissou Moutari, Matthias Dehmer; Mathematical Foundations of Data Science Using R; De Gruyter (2022)
6. Matloff, 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.**

KU3DSCCMT212: GRAPH THEORY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200-299	KU3DSCCMT212	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 Graph Theory, the basic concepts and definitions examples and its applications to daily life.

Course Prerequisite

Higher Secondary Mathematics

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend the basic concepts and definitions of Graph theory.	Understand
2	Apply Graph theory in daily life by Mathematical Modelling.	Apply
3	Understand sub graphs, paths and cycles in a graph	Understand
4	Comprehend the notion of Matrix representation of graphs	Understand
5	Understand Trees, Connectivity, Bridges, Spanning Trees	Understand
6	Apply the notion of Cut vertices and connectivity,	Apply
7	Understand Eulerian graphs and Hamiltonian graphs, .	Understand
8	Apply the notion of the Chinese Postman Problem and The Travelling Salesman Problem	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**	**12**
	1	Introduction	
		a)The definition of a graph	
		b) Graphs as models	
		c) More definitions	
		d) vertex degrees	
		e) Sub graphs	
	2	Paths and cycles ,Matrix representation of graphs, fusion	
		a) Paths and cycles2	
		b) Matrix representation of graphs	
		c) Fusion	

III	**Trees and Connectivity: Definitions and simple properties, Bridges, Spanning Trees**		**12**
	1	Trees and Connectivity	
		a) Definitions and simple properties	
		b) Bridges	
		c) Spanning Trees	
IV	**Cut vertices and connectivity, Euler tours (Fleury's algorithm omitted), the Chinese Postman Problem**		**12**
	1	a) Cut vertices and connectivity	
		b) Euler tours (Fleury's algorithm omitted)	
		c) The Chinese Postman Problem	
		d) The Hamiltonian Graphs	
V	**Teacher Specific Module**		**12**
	Directions		
	1.Fusion algorithm for connectedness		
	2 Connector Problems: Algorithms for finding minimal spanning trees in a graph		
	a) Kruskal's Algorithm,		
	b) Primes Algorithm		
	3.Shortest Path problems		
	a)The Breadth First Search algorithm		
	b) The Back- TrackingT algorithm		
	c)The Dijkstra's algorithm		
	4.Construction of Euler Tour in an Eulerian Graph: Fleury's algorithm		
	4. The Travelling Salesman problem		
	a) The Two- Optimal algorithm		
	b) The closest insertion algorithm		

Essential Readings:

1. John Clark and Derek Allan Holton . "A First Look at Graph Theory" (1995), Allied Publishers Ltd. In association with World Scientific.Publishing Co. Pte Ltd..

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 1.1to 1.5	
II	1	1	Section 1.6	
	2	1	Sections 1.7	
	3	1	Sections 1.8	Fusion Algorithm for connectedness omitted
III	1	1	Sections 2.1	
		1	Sections 2.2	
	2	1	Sections 2.3	Connector problems omitted
IV	1	1	Sections 2.6	
	2	1	Sections 3.1	(Fleury's algorithm omitted)
	3	1	Sections 3.2	
	4	1	Sections 3.3	Proof of theorem 3.6 excluded

Suggested Readings:

1. K.R. Parthasarathy Basic Graph Theory; Tata-McGraw Hill; 1994
2. R. Balakrishnan and K. Ranganathan; A Text Book of Graph Theory (2nd edition); Springer.
3. J.A. Bondy and U.S.R. Murthy; Graph Theory with Applications; Macmillan.
4. F. Harary; Graph Theory; Narosa.
5. NarsinghDEO; Graph Theory with Applications to Engineering and computer Science; PHI Pvt. Ltd.
6. G. Chartrand and P. Zhang; Introduction to Graph Theory; Tata McGraw Hill.
7. J. A. Dossey et al.; Discrete Mathematics; Pearson Education; 2005.

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.

KU4DSCCMT201: REAL ANALYSIS - I

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200-299	KU4DSCCMT201	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 aims to introduce properties of real line $\mathbb{R}$., basic concepts and techniques of real analysis. Also it aims to introduce real sequences, subsequence and to establish convergence of sequences using theorems.

Course Prerequisite

KU3DSCCMT201: INTRODUCTION TO GEOMETRY AND ANALYSIS

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Recognize the fundamental properties of the real numbers, including algebraic, order and completeness properties of R.	Knowledge
2	Identify sequences in terms of functions from $\mathbb{N}$ to a subset of $\mathbb{R}$ and find the limit	Understand
3	Classify whether a sequence is bounded , convergent, divergent, monotone and Cauchy	Understand
4	Apply the Archimedean property and the density theorem in real numbers	Apply
5	Apply Bolzano Weierstrass Theorem and the Cauchy's convergence criterion in real sequences	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	1	**THE REAL NUMBERS**	12
		a) The algebraic and order properties of R	
		b) Absolute Value and the Real Line	
		c) Completeness Property of R	
II	1	**THE REAL NUMBERS**	12
		a) Applications of the Supremum Property	
		b) Intervals	
III	1	**SEQUENCES AND SERIES**	12
		a)Sequence and Their Limits	
		b) Limit Theorems	
		c) Monotone Sequences	
IV	1	**SEQUENCES AND SERIES**	12
		a) Subsequences and Bolzano Weierstrass Theorem	
		b)The Cauchy Criterion	

V	**Teacher Specific Module**	**12**
	Finite , Infinite ,Countable & Uncountable sets	

Essential Readings:

1. R.G Bartle and D.R Sherbert; Introduction to Real Analysis (Fourth edition); Wiley& Sons.
2. Ajit Kumar, S. Kumaresan and Bhaba Kumar Sarma; A Foundation Course; Mathematics, Narosa Publishing House; 2018

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections2.1, 2.2, 2.3	
II	1	1	Section 2.4,2.5	
III	1	1	Sections 3.1, 3.2, 3.3	
IV	1	1	Sections 3.4, 3.5	

Suggested Readings:

1. David Alexander Brannan; A First Course in Mathematical Analysis; Cambridge University Press, US (2006).
2. John M. Howie; Real Analysis; Springer
3. Sudhir R. Ghorpade, Balmohan V. Limaye; A Course in Calculus and Real Analysis; Springer, 2006
4. Houshang H. Sohrab; Basic Real Analysis; Birkhäuser
5. K.A. Ross; Elementary Analysis: The Theory of Calculus; Springer, 2013.
6. J.V. Deshpande; Mathematical Analysis and Applications; Alpha Science International Ltd., 2004.
7. Charles G. Denlinger; Elements of Real Analysis; Jones and Bartlett Publishers Sudbury, Massachusetts (2011).

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.

KU4DSCCMT202: MULTI VARIABLE CALCULUS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200-299	KU4DSCCMT202	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 multivariable functions, their limits, continuity, partial derivatives and multiple integrals and to discuss applications of double and triple integration.

Course Prerequisite

1. Limit and continuity of single variable function.
2. Differentiation and integration of single variable function.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concept of multivariable functions, their limit and continuity	Understand
2	Understand the concept of Partial derivative and apply it to functions	Apply
3	Understand the concept of directional derivative and gradient vector.	Understand
4	Apply the concept of gradient vectors to find maxima and minima.	Apply
5	Understand double and triple integrals, and apply multiple integrals to find surface area	Apply
6	Understand spherical and cylindrical coordinates	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		**Multi variable Functions and Partial derivatives.**	**12**
	1	a) Functions of Several Variables	
		b) Limits and continuity	
	2	Partial Derivatives	
		a) Partial Derivatives	
II		**Tangent Planes and Directional Derivatives**	**12**
	1	a) Tangent Planes and Linear Approximations	
		b) The Chain Rule	
		c) Directional Derivatives and the Gradient Vector	
		d) Maximum and Minimum Values	
III		**Lagrange Multipliers, Multiple Integrals**	**12**
	1	Lagrange Multipliers	
		a) Lagrange Multipliers	
	2	Multiple Integrals	
		a) Double integrals over rectangles	

		b) Double integrals over general regions.	
		c) Double integrals in Polar coordinates	
		d) Applications of double integrals.	
IV	**Applications of double integrals** ,Triple integrals(15.5 to 15.8)		**12**
	1	a) Surface area	
	2	Triple Integrals	
		a) Triple integrals	
		b) Triple integrals in cylindrical coordinates	
		c) Triple integrals in spherical coordinates	
V	**Teacher Specific Module**		**12**
	Jacobian, Change of Variables in Multiple Integrals		

Essential Readings:

1: Calculus Early Transcendental, Metric version, James Stewart, Daniel Clegg, Saleem Watson 9th Edition, Cengage Learning 2021.

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 14.1,14.2	
	2	1	Section 14.3	
II	1	1	Section 14.4,14.5	
	2	1	Sections 14.6,14.7	
III	1	1	Sections 14.8	
	2	1	Sections 15.1 to 15.4	
IV	1	1	Sections 15.5	
	2	1	Sections 15.6,15.7,15.8	

Suggested Readings:

1. H. Anton, I. Bivens and S. Davis; Calculus; 10th edition; Willey
2. G.B Thomas Jr.,M.D Weir and Joel R.Hass; Thomas' Calculus (12th edition),Pearson,2009
3. S.K Stein; Calculus and Analytic Geometry; McGraw Hill, 1992.
4. G.F Simmons; Calculus with analytic Geometry (second edition); McGraw Hill, 1995.

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.

KU4DSCCMT203: INTRODUCTION TO ABSTRACT ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC	200-299	KU4DSCCMT203	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 aims to provide a comprehensive introduction to the fundamental concepts and structures in Group Theory.

Course Prerequisite

Elementary Algebra including sets, relations, functions, equations and basic algebraic structures

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Comprehend the binary operations and their properties in the context of group theory	Understand
2	Recognize and explain the fundamental properties of groups, such as closure, associativity, identity and inverses	Understand
3	Classify and work with finite groups, understanding their structure and significance	Apply
4	Identify and prove isomorphisms between groups, recognizing the importance of structural similarities	Apply
5	Comprehend the notion of subgroups, including the criteria for a subset to be a subgroup	Understand
6	Comprehend the cyclic groups, understanding their generation and properties	Understand
7	Apply Lagrange's theorem to various problems, particularly in the context of finite groups and permutation groups	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		Introduction to Group	12
	1	**Groups**	
		a) Binary Operations	
		b) Groups: Definition and Examples	
		c) Elementary Properties of Groups	
		d) finite Groups and Group Tables	
II		**Subgroups**	12
	1	Isomorphic Binary Structures	
	2	Subgroups, Cyclic subgroups	
		a) Subgroups	
		b) Cyclic subgroups	
		Cyclic Groups & Groups of Permutations	12

III	1	Cyclic Groups	
	2	Groups of Permutations	
IV	The Alternating Group		**12**
	1	a) Orbits	
		b) Cycles	
		c) The Alternating Groups	
V	**Teacher Specific Module**		**12**
	The notion of Coset, Properties of Coset		
	Lagrange's theorem		
	Application of Cosets to Permutation groups: the rotation group of a Cube and Soccer Ball(Relevant Sections from Chapter 7)		

Essential Readings

1. John B. Fraleigh; A First Course in Abstract Algebra; 7th Ed.; Pearson, 2002**.**
2. Joseph A Gallian; Contemporary Abstract Algebra, 9th Edition; Cenage Learning 2017.

Reference Distribution

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Sections 2,4	
II	1	1	Section 3	
	2	1	Sections 5	
III	1	1	Sections 6	
	2	1	Sections 8	
IV	1	1	Sections 9	

Suggested Readings

1. Charles C Pinter; A book of Abstract Algebra; Dover Publications, Inc., Mineola, New York 2010.
2. David S Dummit, Richard M Foote; Abstract Algebra; John Wiley & Sons Inc 2004
3. I N Herstein; Topics in Algebra; Wiley India Pvt Ltd, 2006
4. M Artin; Algebra (Second Edition); Pearson Education India, 2015.

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.

KU5DSCCMT301: REAL ANALYSIS II

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC	300-399	KU5DSCCMT301	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

In this course the student will learn the basic concepts and techniques of Real Analysis. It starts from infinite series, convergence, tests for convergence, Absolute convergence, and conditional convergence. Continuous functions and the fundamental properties of continuous functions on intervals, uniform continuity are also discussed. This course also discuss the Riemann Integrals, properties classes of Riemann Integrable functions and the Fundamental theorem of calculus

Course Prerequisite

Sequences, convergence and test for convergence of sequence.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the Infinite Series, Convergence of the series and tests for the convergence. Also apply it to test the convergence of the given series.	Understand
2	Understand the concepts of Absolute convergence and conditional convergence and apply these concepts to given series.	Understand
3	Understand the various tests for Absolute convergence and non absolute convergence apply them to test the convergence of a given series	Understand
4	Understand the concept of continuous functions and its properties, combinations, uniform continuity and apply the various problems involving continuity.	Understand

5	Understand the concept of Riemann integration, its properties, Fundamental theorems of calculus and apply them in problems and theorems involving integration	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		**Infinite series**	**12**
	1	Introduction to infinite series	
		a) The n^{th} term test	
		b) Cauchy criterion for series	
		c) The comparison tests	
	2	**Absolute convergence**	
		a) Absolute convergence	

		b) Conditional convergence	
		c) Grouping and Re-arrangement of series	
	3	**Test for absolute convergence**	
		a) Limit comparison test II (without proof)	
		b) Root and ratio test (without proof)	
		d) Integral test (without proof)	
		e) Raabe's test (without proof)	
	4	**Test for non-absolute convergence**	
		a) Alternating series test	
		b) The Dirichlet and Abel test	
II	**Continuous Functions**		**12**
	1	**Continuous Functions**	
		a) Continuous Function	
		b) Sequential criteria for continuity	
		c) Discontinuity criteria	
	2	**Combination of continuous functions**	
		a) Combination of continuous functions and examples	
		b) Composition of continuous functions and examples	
	3	**Continuous function on intervals**	
		a) Boundedness theorem (without proof)	
		b) Maximum- Minimum theorem (without proof)	
		c) Location of roots theorem(Without proof)	
		d) Bolzano's intermediate value theorem	
		e) Preservation of intervals theorem	

III	**Uniform Continuity**		**12**
	1	**Uniform continuity**	
		a) Uniform continuity	
		b) Uniform continuity theorem	
	2	**Lipschitz functions**	
		a) Lipschitz function	
		b) Continuous Extension Theorem.	
IV	**The Riemann Integral.**		**12**
	1	**Riemann Integral**	
		a) Definition of Riemann Integral and examples	
		b) Properties of Riemann Integral	
		c) Boundedness Theorem.	
	2	**Riemann Integrable functions**	
		a) Cauchy criteria(without proof)	
		b) The Squeeze theorem (Without proof)	
		c) Classes of Riemann integrable functions	
		d) Additivity theorem (Without proof)	
	3	**The Fundamental theorem**	
		a) The Fundamental theorem of calculus first form	
		b) The Fundamental theorem of calculus second form	
		c) Substitution theorem.	
V	**Additional Topic offered by teacher**		12
	Directions		
	a) Illustrations of the tests for convergence series		
	b) Illustrated Examples and counter examples for the topics in continuous functions		

	c) Illustrated Examples of Riemann Integrable functions	

Essential Readings:

1. Introduction to Real Analysis, Fourth Edn., Robert G. Bartle and Donald R.Sherbert, Wiley India edn.

Reference Distribution:

Module	Unit	Essential Reading No.	Sections	Remarks
I	1	1	Section 3.7	
	2	1	Section 9.1	Excluding the proof of Rearrangement Theorem
	3	1	Section 9.2	Excluding the proof of Integral test and Raabe's Test
	4	1	Section 9.3	Excluding the proof of Abel's lemma, Dirichelet's test and Abel's Test
II	1	1	Section 5.1	
	2	1	Sections 5.2	Excluding the proof of theorems
	3	1	Section5.3	Excluding the proof of boundedness theorem, Maximum-Minimum theorem and the Location of Roots theorem
III	1	1	Sections 5.4.1, 5.4.2 and 5.4.3	
	2	1	Sections 5.4.4, 5.4.5, 5.4.6, 5.4.7 and 5.4.8	Excluding the proof of continuous extension theorem
IV	1	1	Sections 7.1	Excluding the proof of theorems 7.1.2, 7.1.3, 7.1.5 and 7.1.6
		2	Section 7.2	Excluding the proof of theorems 7.2.1, 7.2.3, 7.2.4. and 7.2.5,7.2.7, 7.2.8,7.2.8, and7.2.9
		3	Section 7.3	Excluding the proof of theorems 7.3.1, 7.3.4,7.3.5 and 7.3.8

Suggested Readings

1. 1. J.M. Howie; Real Analysis; Springer; 2007.
2. Ghorpade and Limaye; A Course in Calculus and Real Analysis; Springer; 2006
3. K.A. Ross; Elementary Analysis: The Theory of Calculus; Springer; 2013.
4. J.V. Deshpande; Mathematical Analysis and Applications; Alpha Science International Ltd.; 2004.

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.

MULTIDISCIPLINARY COURSES

KU1MDCCMT101
LOGIC, LATTICES AND BOOLEAN ALGEBRA

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	MDC	100-199	KU1MDCCMT101	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 understand the concept of Sets and lattices and its applications in Boolean Algebra.

Course Prerequisite

Sets, Relations, Functions.

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the Concept of Logic	Understand
2	Understand the concept of Lattices	Understand
3	Understand the concept of Boolean Algebra	Understand
4	Apply Representation 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			✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I		**Logic and Propositional Calculus**	15
		Introduction	
		Proposition and Compound Statements	
		Basic Logical Operations	
		Propositions and Truth Tables	
		Tautologies and Contradictions	
		Logical Equivalence	
		Algebra of Propositions	
		Conditional and Biconditional Statements	
		Arguments	
		Propositional Functions, Quantifiers	
		Negation of Quantified Statements	
II		**Ordered Sets and Lattices**	15
		Introduction	
		Ordered Sets	
		Hasse Diagrams of Partially Ordered Sets	
		Consistent Enumeration	
		Supremum and Infimum	
		Isomorphic (Similar) Ordered Sets	
		Well- Ordered Sets	
		Lattices	
		Bounded Lattices	
		Distributive Lattices	
		Complements, Complemented Lattices	
		Boolean Algebra	

III		Introduction	15
		Basic Definitions	
		Duality	
		Basic Theorems	
		Boolean Algebras as Lattices	
		Representation Theorem	
		Sum-for- Products form for Sets	
		Sum-for- Products form for Boolean Algebras	
		Minimal Boolean Algebra Expressions, Prime Implicants.	

Essential Readings

1. Seymour Lipschutz, Marc Lars Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, Third edition, McGRAW-HILL

Reference Distribution

Module	Unit	Essential Reading No.	Chapters	Remarks
I		1	Chapter 4.1-4.11	
II		1	Chapter 14.1-14.11	
III		1	Chapter 15.1-15.9	

Suggested Readings

1. Seymour Lipschutz; Schaum's Outlines Set Theory and Related Topics, Second Edition; McGRAW-Hill.
2. Ralph P Grimaldi; Discrete and Combinatorial Mathematics An Applied Introduction, Fifth Edition; Addison-Wesley.
3. V K Balakrishnan; Introductory Discrete Mathematics; Dover Publications, INC.

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.

KU2MDCCMT101: NUMERICAL ABILITY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
II	MDC	100-199	KU2MDCCMT101	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 permutation and combination and its applications.

Course Prerequisite

Basic operations in mathematics

Course Outcomes

CO No.	Expected Outcome	Learning Domains
1	Understand the concept of Permutation and Combination	Understand
2	Understand the concept of principle of inclusion and exclusion	Understand
3	Apply principle of Inclusion and Exclusion	Understand
4	Understand the concept of Generating 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			✓				

COURSE CONTENTS

Contents for Classroom Transaction

MODULE	UNIT	DESCRIPTION	HOURS
I	1	Permutations	15
	2	Combinations: Binomial Theorem	
	3	Combinations with Repetition	
II	1	The Principle of Inclusion and Exclusion	15
	2	Generalizations of the Principle	
	3	Derangements: Nothing is in its Right Place	
	4	Rook Polynomials	
	5	Arrangements with Forbidden Positions	
III	1	Introductory Examples	15
	2	Definition and Examples: Calculational Techniques	
	3	Partitions of Integers	
	4	The Exponential Generating Function	

Essential Readings

1. Ralph P. Grimaldi; Discrete and Combinatorial Mathematics (Fourth Edition); Pearson Education.

Reference Distribution

Module	Unit	Essential Readings No.	Chapters	Remarks
I	1	1	Chapter 1.2	
	2	1	Chapter 1.3	
	3	1	Chapter 1.4	
II	1	1	Chapter 8.1	
	2	1	Chapter 8.2	
	3	1	Chapter 8.3	
	4	1	Chapter 8.4	
	5	1	Chapter 8.5	
III	1	1	Chapter 9.1	
	2	1	Chapter 9.2	

	3	1	Chapter 9.3	
	4	1	Chapter 9.4	

Suggested Readings

1. Seymour Lipschutz; Marc Lars Lipson; Schaum's Outline of Theory and Problems of Discrete Mathematics; Third edition; Mc. GRAW-HILL
2. V K Balakrishnan; Introductory Discrete Mathematics; Dover Publications, INC

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.**