PREFACE

In the midst of a transformative era for higher education in our country, the UG Mathematics Board of Studies has embarked on a crucial mission to reshape the undergraduate program's curriculum and syllabus. The primary aim of this restructuring is to achieve academic excellence by nurturing research capabilities among students. Equally important is our goal to seamlessly integrate two vital, interconnected aspects of higher education: employability and skill development.

The programme is structured with Major and Minor courses (DSC, DCC, DCE, DSE etc), Multi-Disciplinary Courses (MDC), Skill Enhancement Courses (SEC), Value Added Courses (VAC), Internship and Research Projects.

Mar Athanasius College (Autonomous), Kothamangalam offers a cutting-edge BSc (Honours) Programme in Mathematics with a specialization in Data Science. Tailored to meet the demands of the digital age, this program provides students with an in-depth grasp of advanced computer programming essential for data analysis. Centered around advanced Python programming, the curriculum delves into intricate models and methodologies crucial for deciphering complex real-world data sets. This specialized training equips graduates with the skills needed to navigate and thrive in the evolving landscape of data-driven industries.

The BSc (Honours) Programme in Mathematics with a specialization in Data Science at Mar Athanasius College (Autonomous), Kothamangalam stands out for its array of distinctive features tailored to nurture well-rounded and adaptable professionals. Firstly, it offers students the flexibility to switch between discipleines of study, allowing them to explore diverse academic interests and tailor their educational journey. This flexibility extends to the opportunity for learners to select courses across all disciplines, promoting a holistic learning experience that aligns with individual passions and career aspirations. Moreover, it hones critical thinking and problem-solving skills through real-life applications, equipping graduates to tackle complex challenges with confidence. Lastly, it places a strong emphasis on research skills, effective communication, community-based engagement, environmental awareness, and fostering a sense of responsibility and accountability, ensuring graduates are well-prepared to make meaningful contributions to society.

I would like to express my sincere gratitude to all the members of the Board of Studies, especially, Dr. B. Kannan Professor (Rt), Department of Computer Application, CUSAT, Dr. Arun K. R. Associate Professor, Department of Mathematics, Indian Institute of Science Education and Research(IISER), Thiruvananthapuram, Dr. Jayaprasad P. N. Professor, Department of Mathematics, Rajiv Gandhi Institute of Technology, Govt. Engineering College, Kottayam. Also I would like to thank Dr. Jeeva Jose, Associate Professor, B. P. C College, Piravom who helped us to design the specialization courses. I also thank Dr. Majid. N. V, Assistant Professor in Mathematics, M. A College, Kothamangalam for coordinating and editing the Under Graduate syllabus in Mathematics.

Dr. Latha S. Nair

Chairman

Board of Studies Mathematics (UG)

Mar Athanasius College (Autonomous), Kothamangalam.

BOARD OF STUDIES IN MATHEMATICS	
NAME	**DESIGNATION**

CHAIRMAN	
Dr. Latha S. Nair	Associate Professor and Head, Dept. of Mathematics, Mar Athanasius College
EXPERTS (2)	
Dr. B. Kannan	Professor, Dept. of Computer Application, CUSAT.
Dr. Arun K. R.	Associate Professor, Dept, of Mathematics, Indian Institute of Science Education and Research(IISER), Thiruvananthapuram.
ONE EXPERT TO BE NOMINATED BY THE VICE CHANCELLOR (MGU)	
Dr. Jayaprasad P. N.	Professor, Dept, of Mathematics, Rajiv Gandhi Institute of Technology, Govt. Engineering College, Kottayam.
MEMBER TEACHERS IN THE DEPARTMENT	
Dr. Rajesh K. Thumbakara	Associate Professor,
Dr. Bino Sebastian V.	Assistant Professor
Dr. Susan Ray Joseph	Assistant Professor
Dr. Mary Elizabeth Antony	Assistant Professor
Dr. Majid N. V.	Assistant Professor
MEMBER FROM INDUSTRY	
Sri. C. J. George	Managing Director, BNP Paribas, Geojith
MERITORIOUS ALUMNUS	
Mathew Thomas	Assistant Professor, Dept, of Mathematics, St. thomas College (Autonomous), Thrissur

Programme Outcomes (PO)

PO 1: Critical thinking and Analytical reasoning

Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

PO 2: Scientific reasoning and Problem solving

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

PO 3: Multidisciplinary/interdisciplinary/transdisciplinary Approach

Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary /interdisciplinary/transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills

Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO 5: Leadership and Entrepreneurship Skills

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. After inculcating all the necessary graduate qualities, a graduate can become an entrepreneur.

PO 6: Social Consciousness and Responsibility

Ability to contemplate of the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior.

PO 9: Networking and Collaboration

Acquire skills to be able to collaborate and network with educational institutions, research organisations and industrial units in India and abroad.

PO 10: Lifelong Learning

Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes

PSO No.	Upon completion of B.Sc. Mathematics programme, the students:	PO No.
PSO-1	Apply Mathematics as a flexible problem-solving instrument that extends across Science and Technology, Commerce and Management, Humanities, and Soft-computing.	1, 2, 3, 9, 10
PSO-2	Pursue advanced studies within the field to contribute to both academic progress and societal development.	3, 5, 6
PSO-3	Innovate by developing novel techniques and methods, grounded in mathematical principles, to address unresolved challenges in various disciplines.	1, 3, 7
PSO-4	Construct mathematical models that simulate real-life problems, facilitatingpredictions, estimations, and regression analysis.	2, 6, 8
PSO-5	Demonstrate effective communication of mathematical concepts through written, computational, and graphical means.	4, 5, 9
PSO-6	Recognize the diverse applications of mathematics across different disciplines and real-world scenarios, thereby enhancing career opportunitiesin various fields and research.	5, 7, 10

Name of the Major Subject: Mathematics
(Specialization in Data Science)

Semester 1

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	**T**	**P**	**O**
M24MT1DSC100	Foundation of Mathematics	DSC	4	5	3	-	2	-
M24MT1MDC100	Applicable Mathematics I	MDC	3	4	2	-	2	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others

Semester 2

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	**T**	**P**	**O**
M24MT2DSC101	Basic Mathematical Techniques	DSC	4	5	3	-	2	-
M24MT2MDC101	Applicable Mathematics II	MDC	3	4	2	-	2	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others

Semester 3

Course Code	*Title of the Course*		*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
						L	**T**	**P**	**O**
M24MT3DSC200	Analytic Geometry, Theory of Equations and Multiple Integrals		DSC A	4	5	3	-	2	-
M24MT3DSC201	Lattices and Vector Calculus		DSC A	4	4	4	-	-	-
M24MT3DSE200	Art of Problem Solving with Python **(S)**	Any One	DSE	4	5	3	-	2	-
M24MT3DSE201	An Invitation to Actuarial Mathematics								
M24MT3DSE202	Game Theory and Project								

	Management								
M24MT3DSC202	Essential Mathematics for Scientific Study		DSC B	4	5	3	-	2	-
M24MT3DSC203	Mathematics for Business and Economics		DSC B	4	5	3	-	2	-
M24MT3MDC200	Mathematics of Nature and Art		MDC	3	3	3	-	-	-
M24MT3VAC200	Mastering Problem Solving through Vedic Mathematics		VAC	3	3	3	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 4

Course Code	***Title of the Course***		***Type of the Course***	***Credit***	***Hours/ Week***	***Hour distribution/ week***			
						L	**T**	**P**	**O**
M24MT4DSC200	Matrix Algebra and Number Theory		DSC A	4	5	3	-	2	-
M24MT4DSC201	Fundamentals of Analysis		DSC A	4	4	4	-	-	-
M24MT4DSE200	Data Processing and Visualization **(S)**	Any One	DSE	4	5	3	-	2	-
M24MT4DSE201	Mathematical Modelling								
M24MT4DSE202	Transforms and Fourier Series								
M24MT4DSC202	Essential Mathematics for Science		DSC B	4	5	3	-	2	-
M24MT4DSC203	Computational Methods for Business and Economics		DSC B	4	5	3	-	2	-
M24MT4VAC200	Business Mathematics		VAC	3	3	3	-	-	-
M24MT4SEC200	Document Preparation using LaTeX		SEC	3	3	3	-	-	-
M24MT4INT200	Internship			2	-	-	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 5

Course Code	***Title of the Course***	***Type of the Course***	***Credit***	***Hours/ Week***	***Hour distribution/ week***			
					L	**T**	**P**	**O**

M24MT5DSC300	A First Course in Complex Analysis		DSC A	4	5	3	-	2	-
M24MT5DSC301	Limits and Convergence		DSC A	4	4	4	-	-	-
M24MT5DSE302	Fundamentals of Groups and Rings		DSC A	4	4	4	-	-	-
M24MT5DSC303	Differential Equations and Applications		DSC A	4	4	4	-	-	-
M24MT5DSE300	Data Analysis Using Python **(S)**	Any One	DSE	4	5	3	-	2	-
M24MT5DSE301	Mathematical MusingsBeyond Classroom								
M24MT5DSE302	An Invitation to FuzzyMathematics								
M24MT5DSE303	Exploring the Harmonyof Automata								
M24MT5SEC300	Operation Research		SEC	3	3	3	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 6

Course Code	***Title of the Course***		***Type of the Course***	***Credit***	***Hours/ Week***	***Hour distribution/ week***			
						L	**T**	**P**	**O**
M24MT6DSC300	Mathematical Analysis		DSC A	4	4	4	-	-	-
M24MT6DSC301	Fundamentals of Linear Algebra		DSC A	4	5	3	-	2	-
M24MT6DSC302	Application of Calculus and Linear Algebra in Finance		DSC A	4	5	3	-	2	-
M24MT6DSE300	Introduction Machine Learning Using Python **(S)**	Any One	DSE	4	5	3	-	2	-
M24MT6DSE301	Investment Science								
M24MT6DSE302	Combinatorics								
M24MT6DSE303	Fundamentals of Fluid Dynamics								
M24MT6DSE304	Computations and Graphics Using Scilab								
M24MT6SEC300	Numerical Methods		SEC	3	3	3	-	-	-
M24MT6VAC300	Mathematical Computation and Visualization with R		VAC	3	3	3	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 7

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	**T**	**P**	**O**
M24MT7DCC400	Advanced Linear Algebra	DCC	4	5	3	-	2	-
M24MT7DCC401	Theory of Complex Functions	DCC	4	4	4	-	-	-
M24MT7DCC402	Introduction to Metric Spaces	DCC	4	4	4	-	-	-
M24MT7DCE400	Advanced Theory of Groups and Rings	DCE	4	4	4	-	-	-
M24MT7DCE401	Real Analysis	DCE	4	4	4	-	-	-
M24MT7DCE402	Graph Theory	DCE	4	4	4	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O –Others

Semester 8

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	**T**	**P**	**O**
M24MT8DCC400	Functional Analysis	DCC	4	5	3	-	2	-
M24MT8DCC401	Measure Theory and Integration	DCC	4	5	3	-	2	-
M24MT8DCE400	Basic Topology	DCE	4	5	3	-	2	-
M24MT8DCE401	Field Theory	DCE	4	5	3	-	2	-
M24MT8DCE402	Optimization Techniques	DCE	4	5	3	-	2	-
M24MT8PRJ400	Project (UG Honours with Research)		12	Honours with Research – 2 DCC + Project				
M24MT8PRJ401	Project (UG Honours)		8	Honours – 2 DCC + 1 DSC/DCE + Project OR 2 DCE				

L – Lecture, T – Tutorial, P – Practical/Practicum, O –Others

Scheme of instructional Credit and Hours

Sl. No.	Semester	Course Type	Course Name	Credit	Hours/ week	Hours/ Semester
1	1	DSC A	Foundations of Mathematics	4	5	90
2	2	DSC A	Basic Mathematical Techniques	4	5	90
3	3	DSC A	Analytic Geometry, Theory of Equations and multiple Integrals	4	5	90
4	3	DSC A	Lattices and Vector Calculus	4	4	72
5	4	DSC A	Matrix Algebra and Number Theory	4	5	90
6	4	DSC A	Fundamentals of Analysis	4	4	72
7	5	DSC A	A First Course in Complex Analysis	4	5	90
8	5	DSC A	Limits and Convergence	4	4	72
9	5	DSC A	Fundamentals of Groups and Rings	4	5	90
10	5	DSC A	Differential Equations and Applications	4	4	72
11	6	DSC A	Mathematical Analysis	4	4	72
12	6	DSC A	Fundamentals of Linear Algebra	4	5	90
13	6	DSC A	Applications of Calculus and Linear Algebra in Finance	4	5	90
14	7	DCC	Advanced Linear Algebra	4	5	90
15	7	DCC	Theory Of Complex Functions	4	4	72
16	7	DCC	Basic Topology	4	4	72
17	7	DCC	Advanced Theory of Groups and Rings	4	4	72
18	7	DCC	Real Analysis	4	4	72

19	7	DCC	Graph Theory	4	4	72
20	8	DCC	Functional Analysis	4	5	90
21	8	DCC	Measure Theory and Integration	4	5	90
22	8	DCC	Advanced Topology	4	5	90
23	8	DCC	Field Theory	4	5	90
24	8	DCC	Optimization Techniques	4	5	90
25	3	DSC B	Essential Mathematics for Scientific Study	4	5	90
26	3	DSC B	Mathematics for Business and Economics	4	5	90
27	3	DSC B	Essential Mathematics for Science	4	5	90
28	3	DSC B	Computational Methods for Business and Economics	4	5	90
29	3	DSC Elective	Art of Problem Solving with Python (S)	4	5	90
30	3	DSC Elective	An Invitation to Actuarial Mathematics	4	5	90
31	3	DSC Elective	Game Theory and Project Management	4	5	90
32	4	DSC Elective	Data Processing and Visualization (S)	4	5	90
33	4	DSC Elective	Mathematical Modelling	4	5	90
34	4	DSC Elective	Transforms and Fourier Series	4	5	90
35	5	DSC Elective	Data Processing and Visualization (S)	4	5	90
36	5	DSC Elective	Mathematical Musings Beyond Classroom	4	5	90
37	5	DSC Elective	An Invitation to Fuzzy Mathematics	4	5	90

38	5	DSC Elective	Exploring the Harmony of Automata	4	5	90
39	6	DSC Elective	Introduction Machine Learning Using Python (S)	4	5	90
40	6	DSC Elective	Investment Science	4	5	90
41	6	DSC Elective	Combinatorics	4	5	90
42	6	DSC Elective	Fundamentals of Fluid Dynamics	4	5	90
43	6	DSC Elective	Computations and Graphics Using Scilab	4	5	90
44	1	MDC	Applicable Mathematics I	3	4	72
45	2	MDC	Applicable Mathematics II	3	4	72
46	3	MDC	Mathematics of Nature and Art	3	3	54
47	3	VAC	Mastering Problem Solving throughVedic Mathematics	3	3	54
48	4	VAC	Business Mathematics	3	3	54
49	6	VAC	Mathematical Computation and Visualization with R	3	3	54
50	4	SEC	Document Preparation using LaTeX	3	3	54
51	5	SEC	Operation Research	3	3	54
52	6	SEC	Numerical Methods	3	3	54

Semester 1

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /week			
					L	T	P	O
M24MT1DSC100	Foundation of Mathematics	Discipline Specific Component-DSC A	4	5	3	0	2	0
M24MT1MDC100	Applicable Mathematics I	Foundation Component MDC	3	4	2	0	2	0

Discipline Specific Component (DSCA)

Foundations of Mathematics

	**Mar Athanasius College (Autonomous), Kothamangalam** **FYUGP SYLLABUS**
Programme	**B Sc Mathematics**
Course Name	**Foundations of Mathematics**
Type of Course	**Discipline Specific Component (DSC A)**
Course Code	**M24MT1DSC100**
Course Level	**100**
Course Summary	This course provides a solid foundation in both mathematical logic and the principles of calculus. Beginning with "Basic Logic", students explore propositional logic, propositional equivalence, predicates, and quantifiers. The course then transitions to "Functions", covering the basics of functions and their graphs, combining functions through shifting and scaling, and introducing inverse functions. The core of the course is dedicated to "Derivatives", where students are introduced to techniques of differentiation without formal proof, higher derivatives, product and quotient rules, derivatives of trigonometric functions using formulas, the chain rule, and implicit differentiation. The focus is on practical applications, preparing students for real-world problem-solving. The course concludes with an exploration of the "Applications of Derivatives", emphasizing the analysis of functions. Topics include determining intervals of increase, decrease, and concavity, identifying relative extrema with geometric implications of multiplicity, applying L'Hôpital's Rule, and addressing indeterminate forms.

Semester	**1**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/Week
		3	0	2	0	**5**
Pre- requisites, If any	Sets, Set operations and Limits					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand the language of Mathematics andcommunicate in a proper way.	U	1,2,3,4
2	Understand the geometry of basic functions and theirproperties.	U	1,2,3
3	Understand and apply the process of differentiation.	A	1,2,3,6
4	Apply L'Hôpital's rule to evaluate indeterminate forms.	A	1,2
5	Experience graphing tools in doing and enjoying Mathematics	S	1,2,3,4,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Basic Logic**		**15**
	1.1	Propositional Logic	1	
	1.2	Propositional Equivalence	1	
	1.3	Predicates and Quantifiers	1	
		Problems (Practicum)	1	
	Text 2: Chapter 1- Sections: 1.1, 1.3, 1.4			

2		**Functions**		
	2.1	Set, Set operations, Set identities (Review)	1	
	2.2	Functions and their graphs (excludingrepresenting functions numerically)	2	**20**
	2.3	Combining Functions: Shifting and scalingGraphs	2	
	2.4	Inverse Functions	2	
		Problems (Practicum)	1, 2	
	Text 3: Chapter 1 - Sections: 1.1, 1.2, Chapter 7 - Section: 7.1 (Inversefunctions only)			
3		**Derivatives**		
	3.1	Introduction to Techniques of Differentiation(without proof)	1, 3, 5	
	3.2	Higher derivatives, The product and quotientrules	1, 3	**20**
	3.3	Derivatives of trigonometric functions (Using formulas only)	1, 3	
	3 .4	Chain Rule	1, 3	
	3.5	Implicit Differentiation	1, 3	
		Problems (Practicum)	1, 3,5	
	Text 1: Chapter 2 - Sections: 2.3 to 2.7			
4		**Applications of derivatives**		
	4.1	Analysis of Functions I: Increase, decrease andconcavity	1, 3, 5	
	4.2	Analysis of Functions II: Relative extrema	1, 3, 5	**20**
	4.3	L'Hôpital's Rule	1, 4	
	4.4	Indeterminate forms	1, 4	
		Problems (Practicum)	1,3, 4, 5	
	Text 1: Chapter 3 - Sections: 3.1, 3.2 (Geometric implications of multiplicity,Analysis of polynomials excluded), Chapter 6 - Section:6.5			

<table>
<tr><td colspan="7">Practicum</td></tr>
<tr><td colspan="7">Practicum is designed to provide supervised practical applicationof theoretical knowledge and skills.
It's purpose is to encourage creativity and develop ProblemSolving Skills.
The practicum component is to be done in the classroom under thestrict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwrittencopy of the solutions should be kept in the department.</td></tr>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td rowspan="15">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="7"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
</table>

		Number of questions to beanswered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Anton, Howard, Irl Bivens, Stephen Davis. *Calculus*. 10th ed. John Wiley &Sons, Inc., 2012.
2. Rosen, Kenneth H. *Discrete Mathematics and Its Applications* (7th ed.). McGrawHill Publishing Co. New Delhi, 2013.
3. Thomas, George B., Jr., and Maurice D. Weir. *Thomas' Calculus***.** 12th ed. Pearson, 2009.

SUGGESTED READINGS:

1. Hofstadter, Douglas R. *Gödel, Escher, Bach: An Eternal Golden Braid*. Expandeded. Basic Books, 2007.
2. Copi, Irving M., Carl Cohen. *Introduction to Logic*. 5th ed. Routledge, 2018.
3. Stewart, James. *Calculus: Early Transcendentals*. 10th ed. Cengage Learning, 2023.
4. Thompson, Silvanus P. *Calculus Made Easy*. 5th ed. Dover Publications, 2014.
5. Thomas, George B., Jr., and Maurice D. Weir. *Thomas' Calculus*. 15th ed. Pearson,2023.

ADVANCED READINGS:

1. Hurley, Patrick J. *A Concise Introduction to Logic*. 11th ed. WadsworthPublishing, 2018.
2. Copi, Irving M., Carl Cohen. *Symbolic Logic*. 13th ed. W.W. Norton &Company, 2019.
3. Davis, Philip J. *Advanced Calculus*. 7th ed. Wiley-Interscience, 2002.
4. Tu, Loring W. *Introduction to Manifolds*. 3rd ed. Springer, 2012.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Determine the output of a combinatorial circuit constructed using basic logic gates. Also Build a digital circuit produces the required output. (Eg: Build a

digital circuit that producesthe output $(p \vee \neg r)$ A $(\neg p \vee (q \vee \neg r))$ with input bits p, q and .

- Determine whether a given function is injective or surjective using horizontal line test.
- Using a graphing calculator, visualize the effect of stretching and scaling (horizontal&vertical) of functions.
- Using a graphing calculator, plot the inverse of graphs and understand the geometricrelationship between a graph and its inverse.
- Match the graphs of functions with the graphs of their derivatives. (Eg: Question 23 ofsection 2.2 in text 3).
- Use a graphing utility to make rough estimates of the locations of all horizontal tangent lines(Eg: Question 49 & 50 of section 2.3 in text 3).
- Use a graphing utility to make rough estimates of the intervals on which fr(x) > 0 (Eg:Questions 63 & 64 of section 2.3 in text 3).
- Use the implicit plotting capability of a CAS to graph a curve. (Eg: Question 45 of section
  2.7 in text 3), Suggested software: Desmos, GeoGebra etc.

Foundation Component - MDC
Applicable Mathematics I

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Applicable Mathematics I</td></tr>
<tr><td>Type of Course</td><td colspan="6">Foundation Component - MDC</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT1MDC100</td></tr>
<tr><td>Course Level</td><td colspan="6">100</td></tr>
<tr><td>Course Summary</td><td colspan="6">This competitive exam-focused mathematics course covers crucial topics like number systems, logical reasoning, data analysis, and mathematical measurements. This course explores concepts such as HCF, LCM, fractions, ratio, percentage, and time-related problem-solving, providing comprehensive preparation for various competitive examinations.</td></tr>
<tr><td>Semester</td><td>1</td><td colspan="3">Credits</td><td colspan="2">3</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Nil</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Develop a solid understanding of various types of numbers. Master techniques for calculating HCF and LCM and gain proficiency in simplifications, squares and square roots.	K, U, E	1,2,3
2	Acquire logical reasoning skills by exploring concepts such as ratio, proportion, percentage, and solving problems related to profit, loss and age and apply these principles to real world scenarios.	K, U, E	1,2,3,4
3	Learn the essentials of data analysis, including concepts of simple interest, compound interest and solving calendar problems. Develop analytical skills to interpret and utilize data effectively.	K, U, A	1,2,3
4	Gain expertise in mathematical measurements through topics like time and work, time and distance, and stocks and shares. Apply mathematical concepts to solve practical problems in these areas.	K, A, E	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Number System and Numerical Techniques**		**18**
	1.1	Type of Numbers	1	
	1.2	HCF and LCM of Numbers	1	
	1.3	Decimal Fractions, Simplification	1	
	1.4	Square Roots and Cube Roots	1	
		Problems (Practicum)	1	
	Text 1: Relevant Portions			
2		**Logical Reasoning & Data Analysis**		**24**
	2.1	Ratio and Proportion	2	
	2.2	Percentage	2	
	2.3	Profit and Loss	2	
	2.4	Problems on Ages	2	
	2.5	Simple Interest & Compound Interest	3	
	2.6	Calendar	3	
		Problems (Practicum)	2, 3	
	Text 1: **Relevant Portions**			
3		**Mathematical Measurements**		**18**
	3.1	Time and Work	4	
	3.2	Time and Distance	4	
	3.3	Stocks and Shares	4	
		Problems (Practicum)	4	
	Text 1: Relevant Portions			

4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="11">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture and Tutorial</td></tr>
<tr><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td rowspan="3">A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td rowspan="5">B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td colspan="5">Question Pattern
[Maximum Time 90 Minutes, Maximum Marks 50]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>1 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>4</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td>II</td><td>4</td><td>2</td><td>2</td><td>8</td></tr>
</table>

		III	4	2	1	**7**
		Total no of questions	**12**	**6**	**4**	**22**
		Number of questions to beanswered	**10**	**4**	**2**	**16**
		Total Marks	**10**	**20**	**20**	**50**

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TEXT BOOK:

1. Aggarwal, R.S. *Quantitative Aptitude,* Sultan Chand and company Ltd, New Delhi, 2017.

SUGGESTED READINGS:

1. Abhijit Guha, *Quantitative Aptitude for Competitive Examinations*, McGraw HillEducation 2011.

2. Tyra M., *Magical Book on Quicker Maths*., BSC Publishing Company, 2018.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Discuss different number systems, such as decimal, binary, octal, and hexadecimal,and their conversions.
- Show how number theory concepts apply in various real-life scenarios, likecryptography or data encoding.
- Provide examples where LCM and HCF are used, such as in simplifying fractions,adding and subtracting fractions, or solving equations.
- Incorporate problems where knowledge of roots is essential, such as in Geometry,Physics, or Engineering.
- Provide examples where ratios and proportions are used in real-life situations, such asin finance, cooking, or map scales.
- Provide examples of profit and loss situations in business, trading, and investmentscenarios.
- Discuss problem-solving strategies for analyzing profit and

loss situations anddetermining the best course of action.

- Provide examples of interest calculations in banking, investments, loans, and savingsaccounts.
- Show the difference between simple interest and compound interest and how theyaffect the total amount over time.
- Provide examples of time and work problems in production scenarios, team projects,or construction projects.

Semester 2

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /week			
					L	T	P	O
M24MT2DSC100	Basic Mathematical Techniques	Discipline Specific Component- DSC A	4	5	3	0	2	0
M24MT2MDC100	Applicable Mathematics II	Foundation Component - MDC	3	4	2	0	2	0

Discipline Specific Component (DSC A)

Basic Mathematical Techniques

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Basic Mathematical Techniques</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT2DSC100</td></tr>
<tr><td>Course Level</td><td colspan="6">100</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course is designed to provide students with a deeper understanding of calculus and linear algebra concepts. The course begins with "Partial Differentiation", covering partial derivatives, the chain rule, and the analysis of extreme values and saddle points.It then progresses into "Integral Calculus," focusing on definite integrals, double integrals, integration methods, and the fundamental theorem of calculus.

The course further explores "Matrices", where students delve into linear systems, coefficient matrices, augmented matrices, and matrix operations such as Gauss elimination and back substitution. Elementary row operations, row-equivalent systems, and the various cases of systems in Gauss elimination are covered, leading to the understanding of row echelon form and its implications.

The final segment of the course introduces "Graph Theory," covering foundational definitions and examples. Topics include connectedness, adjacency, subgraphs, matrix representations, null graphs, complete graphs, cyclic graphs, path graphs, wheels, regular graphs, bipartite graphs, and the complement of a simple
graph</td></tr>
<tr><td>Semester</td><td>2</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand the concept of partial derivatives andexperience its applications	U	1,2,3,6
2	Compute definite integrals of single-variable functions, double integrals and understanding theirgeometric interpretation.	A	1,2,3,4
3	Apply matrices to solve systems of linear equations using methods of Gaussian elimination and matrixinversion.	A	1,2,3,
4	Create an insight into the basics of graph theory	C	1,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Partial Differentiation**		**20**
	1.1	Partial derivatives	1	
	1.2	The Chain rule	1	
	1.3	Extreme values and saddle points	1	
		Problems (Practicum)	1	
	Text 3: Chapter 14 - Sections: 14.3, 14.4, 14.7			
2		**Integral Calculus: Definite integrals anddouble integrals**		

	2.1	Integrals and Integration methods (Review)	2	**20**
	2.2	The Definite Integral	2	
	2.3	The Fundamental Theorem of Calculus (Proofof theorems excluded)	2	
	2.4	Double Integrals over rectangular regions	2	
		Problems (Practicum)	2	
	Text 1: Chapter 7 - Section: 7.1; Chapter 4 - Sections: 4.5 (discontinuities and integrability excluded), 4.6(dummy variables, The mean value theorem for integrals and integrating rates of changes excluded); Chapter - section: 14 - 14.1			
3		**Matrices**		**20**
	3.1	Linear System, Coefficient Matrix, AugmentedMatrix	3	
	3.2	Gauss Elimination and Back Substitution	3	
	3.3	Elementary Row Operations, Row-Equivalent Systems	3	
	3 .4	Gauss Elimination: The three Cases of systems	3	
	3.5	Row Echelon Form and Information from It	3	
		Problems (Practicum)	3	
	Text 2: Chapter 7 -Section:7.3			
4		**Graph Theory**		**15**
	4.1	Definitions and examples	4	
	4.2	Connectedness, Adjacency	4	
	4.3	Subgraphs	4	

	4.4	Matrix Representations	4	
	4.5	Null graphs, Complete graphs, cyclic graphs,path graphs and wheels	4	
	4.6	Regular graphs, Bipartite graphs, Complementof a simple graph	4	
		Problems (Practicum)	4	
	Text 4: Chapter 2, Sections: 2(Isomorphism excluded), 3 (cubes , platonic graphs and three puzzles are excluded)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
It's purpose is to encourage creativity and develop Problem solving skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**
	Lecture, Tutorial and Activity oriented
	MODE OF ASSESSMENT

<table>
<tr><td rowspan="11">Assessment Types</td><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="7"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Anton, Howard, Irl Bivens, Stephen Davis. *Calculus*. 10th ed. John Wiley &Sons, Inc., 2012.
2. Kreyszig, Erwin**.** *Advanced Engineering Mathematics***.** 9th ed. Wiley International, 2011.
3. Thomas, George B., Jr., and Maurice D. Weir. *Thomas' Calculus***.** 12th ed. Pearson, 2009.
4. Wilson, Robin J. *Introduction to Graph Theory***.** 4th ed. Addison Wesley LongmanLimited, Edinburgh Gate, Harlow, Essex CM20 2JE, England, 1996.

SUGGESTED READINGS:

1. Chartrand, Gary, and Ping Zhang. *A First Course in Graph Theory*. 2nded. Pearson, 2013.
2. Spivak, Michael. *Calculus and Applications*. 11th ed. Pearson, 2023.
3. Stewart, James. *Calculus: Early Transcendentals*. 10th ed. Cengage Learning, 2023.
4. Thompson, Silvanus P. *Calculus Made Easy*. 5th ed. Dover Publications, 2014.
5. Thomas, George B., Jr., and Maurice D. Weir. *Thomas' Calculus*. 15th ed. Pearson,2023.

ADVANCED READINGS:

1. Axler, Sheldon. *Linear Algebra Done Right*. 3rd ed. Springer, 2015.
2. Evans, Lawrence C. *Partial Differential Equations: An Introduction*. 2nd ed.American Mathematical Society, 2010.
3. Diestel, Reinhard. *Graph Theory*. 5th ed. Springer, 2017.
4. Fichtenholz, Grisha M. *Integration of Functions of Several variables*. 2nd ed.American Mathematical Society, 2010.
5. Strang, Gilbert. *Introduction to Linear Algebra*. 5th ed. Wellesley-CambridgePress, 2016.
6. West, Douglas B. *Introduction to Graph Theory*. 6th ed. Pearson, 2017.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Demonstrate how to visualize tangent planes to surfaces at a specific point usingpartial derivatives.
- Check how to obtain absolute maximum using partial derivatives.
- Use Microsoft excel or spreadsheet to performs basic matrix operations.
- Find the integrals using integration by parts (Problem Solving).
- Integrate rational functions by partial fractions (Problem Solving).
- Finding areas using definite integrals.
- Find the adjacency matrix of some familiar graphs.
- Find the incidence matrix of some familiar graphs

Foundation Component - MDC
Applicable Mathematics II

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous),
Kothamangalam

FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>ourse Name</td><td colspan="6">Applicable Mathematics</td></tr>
<tr><td>Type of Course</td><td colspan="6">Foundation Component - MDC</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT2MDC100</td></tr>
<tr><td>Course Level</td><td colspan="6">100</td></tr>
<tr><td>Course Summary</td><td colspan="6">Through this course, students are able to investigate the fundamental principles of quantitative techniques, delving into matrices, their algebraic operations, and specialized types. Navigate the world of polynomials, focusing on quadratic and cubic equations and learning their solutions and factorization. Discover the power of permutations and combinations through factorial notation, with practical applications. Finally, grasp the dynamics of variable rates of change by knowing basic functions and differentiation principles. This course provides students with the necessary mathematical tools for real-world problem-solving and analytical thinking.</td></tr>
<tr><td>Semester</td><td>2</td><td colspan="3">Credits</td><td colspan="2">3</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Nil</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand and apply matrix algebra	U, A	1, 2, 3
2	Apply quadratic and cubic polynomial techniques,factorization, and solution of quadratic equations to solve problems.	K, U, A	1,2, 4
3	Utilize factorial notation, permutations,combinations, and their applications to solve combinatorial problems.	U, A	1, 2, 6
4	Apply differentiation principles, standard rules, and elementary functions to interpret and solve problems involving variable rates encountered in competitive exams.	K, U, A	2, 6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Matrices & Polynomials**		
	1.1	Matrices, Different types of matricesassociated with a matrix	1	
	1.2	Some special types of matrices	1	
	1.3	Algebra of matrices	1	**24**

	1.4	Quadratic and cubic polynomials	2	
	1.5	Solution of quadratic polynomials	2	
	1.6	Factorisation of quadratic polynomials	2	
		Problems (Practicum)	1, 2	
	Text 1: Chapter 1– Sections: 1.4 to 1.6; Chapter 2 - Sections: 2.3 to 2.7Text 2: Relevant Portions of chapter 10 (Elementary Algebra)			

2		**Permutation and Combination**		**18**
	2.1	Factorial notation	3	
	2.2	Permutations & its applications	3	
	2.3	Combinations & its applications.	3	
		Problems (Practicum)	3	
	Text 2: Chapter 14 (Permutation & Combination)			
3		**Differentiation**		**18**
	3.1	Introduction to techniques of differentiation	4	
	3.2	The product and quotient rules	4	
	3.3	Derivatives of trigonometric functions (using formulas only)	4	
	3.4	The chain rule	4	
		Problems (Practicum)	4	
	Text 3: Chapter 2 - Sections 2.3 to 2.6 (without proof of rules/ theorems)			
4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc.as specified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td></td><td colspan="5">Lecture and Tutorial</td></tr>
<tr><td rowspan="14">Assessment Types</td><td colspan="5">MODE OF ASSESSMENT</td></tr>
<tr><td rowspan="3">A</td><td colspan="4">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td colspan="3">Components</td><td>Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td>5 Marks</td></tr>
<tr><td rowspan="10">B</td><td colspan="4">Semester End Examination (Written)</td></tr>
<tr><td colspan="4">Question Pattern
[Maximum Time 90 Minutes, Maximum Marks 50]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td></tr>
<tr><td>1 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>II</td><td>4</td><td>2</td><td>2</td></tr>
<tr><td>III</td><td>4</td><td>2</td><td>1</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>6</td><td>4</td></tr>
<tr><td>Number of questions to be</td><td>10</td><td>4</td><td>2</td></tr>
</table>

		answered			
		Total Marks	**10**	**20**	**20**

TEXT BOOKS:

1. Shanti Narayan, Mittal P. K., *Text book of Matrices*, S. Chand.
2. M. Tyra, *Magical Book on Quicker Maths*., BSC Publishing Company, 2018.
3. Howard Anton, Irl Bivens, Stephens Davis. *Calculus*, 10th ed. John Wiley &Sons, Inc., 2012.

SUGGESTED READINGS:

1. Aggarwal, R.S. *Quantitative Aptitude*, Sultan Chand and company Ltd, NewDelhi, 2017.
2. Thomas, George B., Jr., and Maurice D. Weir, *Thomas' Calculus***,** 12th ed. Pearson, 2009.
3. Edward, Joseph. *Differential Calculus for beginners*, Nabu Press, 2011.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Discuss different aspects of matrix algebra, including determinant calculation, matrixequations, and solving systems of linear equations using matrices.
- Discuss higher degree polynomials and various methods of polynomial factorization,such as synthetic division, long division and factoring by grouping.
- Illustrate how polynomial equations are represented graphically and how to interpretthe behaviour of polynomial functions.
- Include real-life application problems involving permutations and combinations, suchas probability, arrangements, and selections.
- Illustrate the applications of derivatives in various fields, such as Physics, Economics,Commerce and Engineering.
- Discuss proofs of differentiation rules or theorems in the sections 2.3, 2.4, 2.5, 2.6 ofText 3

Semester 3

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /week			
					L	T	P	O
M24MT3DSC200	Analytic Geometry, Theory of Equations and Multiple Integrals	Discipline Specific Component- DSC A	4	5	3	0	2	0
M24MT3DSC201	Lattices and Vector Calculus	Discipline Specific Component- DSC A	4	4	4	0	0	0
M24MT3DSE200	Art of Problem Solving with Python	Discipline Specific Elective - DSE	4	5	3	0	2	0
M24MT3DSE201	An Invitation to Actuarial Mathematics	Discipline Specific Elective - DSE	4	5	3	0	2	0
M24MT3DSE202	Game Theory and Project Management	Discipline Specific Elective - DSE	4	5	3	0	2	0
M24MT3DSC202	Essential Mathematics for Scientific Study	Discipline Specific Component - DSC B	4	5	3	0	2	0
M24MT3DSC203	Mathematics for Business and Economics	Discipline Specific Component - DSC B	4	5	3	0	2	0
M24MT3MDC200	Mathematics of Natureand Art	Foundation Component - MDC	3	3	3	0	0	0
M24MT3VAC200	Mastering Problem Solving through Vedic Mathematics	Foundation Component - VAC	3	3	3	0	0	0

Discipline Specific Component (DSC A)

Analytic Geometry, Theory of Equations and Multiple Integrals

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous),
Kothamangalam

FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Analytic Geometry, Theory of Equations and Multiple Integrals</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT3DSC200</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course provides a comprehensive exploration of three key areas in advanced mathematics: Analytic Geometry, Theory of Equations, and Multivariable Calculus. Students will delve into the parametrization of plane curves, polar coordinates, conic sections, and conics in polar coordinates. The Theory of Equations section covers roots of equations, relationships between roots and coefficients, transformations of equations, characteristics, and positions of roots, as well as essential theorems and Descartes' rule of signs.

The course progresses into the realm of multivariable calculus, introducing double integrals. Students will learn to evaluate double integrals over general regions, compute areas using double integration, and apply double integrals in polar forms. The focus then shifts to triple integrals, exploring rectangular, cylindrical, and spherical coordinates. Substitutions in both double and triple integrals are covered, enhancing students' problem-solving capabilities.

This course aims to equip students with advanced mathematical tools and problem-solving skills, preparing them for further studies in
mathematics or related fields.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Demonstrate proficiency in parametrizing planecurves and working with polar coordinates.	A	1,2,3,4,5
2	Analyse conic sections and conics in polarcoordinates.	An	1,2,3
3	Understand the relationship between roots and coefficients in equations.	U	1,2,3,4,5
4	Utilize double integrals for area computations andproblem-solving in polar forms.	A	1,2,3,6
5	Master triple integrals in rectangular, cylindrical,and spherical coordinates.	A	1,2,3,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO. No:	Hours
1		**Analytic Geometry**		**20**
	1.1	Parametrization of Plane curves	1	
	1.2	Polar Coordinates	1	
	1.3	Conic sections	2	
	1.4	Conics in polar coordinates	2	
		Problems (Practicum)	1, 2	
	Text 2: Chapter 11 - Sections: 11.1 (Brachistochrone and Tautochrone excluded), 11.3, 11.6 & 11.7			
2		**Theory of Equations**		

	2.1	Roots of Equation and Relation connecting theroots and coefficients of equation	3	**15**
	2.2	Transformation of Equations and special cases	3	
	2.3	Character and Position of the roots of anequation	3	
	2.4	Some general theorems (without proof) andDescartes' rule of signs (without proof)	3	
		Problems (Practicum)	3	
	Text 1: Chapter 6 – Sections: 6.1 to 6.4, 6.7 to 6.10			
3		**Double integrals**		**20**
	3.1	Double integrals over general regions	4	
	3.2	Area by double integration	4	
	3.3	Double integrals in Polar Forms	4	
	Text 2: Chapter 15 - Sections: 15.2 to 15.4			
4		**Triple Integrals**		**20**
	4.1	Triple Integrals in Rectangular Coordinates	5	
	4.2	Triple Integrals in Cylindrical and SphericalCoordinates	5	
	4.3	Substitutions in Double Integrals	4, 5	
	4.4	Substitutions in Triple Integrals	5	
		Problems (Double and Triple integrals)(Practicum)	4, 5	
	Text 2: Chapter 15 - Sections: 15.5, 15.7 & 15.8			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching andLearning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="6"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td></td><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
</table>

		Number of questions to beanswered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Bernard, S., J. M. Child. *Higher Algebra*. AITBS Publishers, India
2. Thomas, George B., Jr., Maurice D. Weir. *Thomas' Calculus*, 12th ed. Pearson, 2009.

SUGGESTED READINGS:

1. Berling, William P. *Journey through Genius: The Great Theorems of Algebra and TheirProofs*. Revised ed. Springer, 2016.
2. Spivak, Michael. *Calculus and Applications*. 11th ed. Pearson, 2023.
3. Stewart, James. *Calculus: Early Transcendentals*. 10th ed. Cengage Learning, 2023.
4. Stewart, James. *Multivariable Calculus*. 9th ed. Cengage Learning, 2023.
5. Thompson, Silvanus P. *Calculus Made Easy*. 5th ed. Dover Publications, 2014.
6. Thomas, George B., Jr., and Maurice D. Weir. *Thomas' Calculus*. 15th ed. Pearson,2023.

ADVANCED READINGS:

1. Artin, Michael. *Algebra: Structures and Applications*. 5th ed. Springer, 2011.
2. Byron, Frederick W., and Robert W. Fuller. *Advanced Analytic Geometry*. 2nd ed DoverPublications, 1970.
3. Evans, Lawrence C. *Algebraic Number Theory*. 2nd ed. Cambridge UniversityPress, 2019.
4. Davis, Philip J. *Advanced Calculus*. 7th ed. Wiley-Interscience, 2002.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Construct a cycloid artwork by tracing the path of a point on a rolling cycle.
- Solve Cubic equations.
- Solve Bi-quadric equation.
- Use double integrals to calculate surface area of three- dimensional object.
- Visualize 3-D surface using any computer software (GeoGebra, Scilab etc).

Discipline Specific Component (DSC A)

Lattices and Vector Calculus

	**Mar Athanasius College (Autonomous), Kothamangalam** **FYUGP SYLLABUS**
Programme	**B Sc Mathematics**
Course Name	**Lattices and Vector Calculus**
Type of Course	**Discipline Specific Component (DSC A)**
Course Code	**M24MT3DSC201**
Course Level	**200**
Course Summary	This course serves as an essential bridge to advanced mathematical concepts, focusing on the development of proof techniques, an in- depth exploration of relations, equivalence relations, partial ordering, vector differentiation, and vector integration. Students will gain proficiency in constructing and understanding mathematical proofs, explore the properties of relations, and delve into the derivatives and integrals of vector functions. The course begins with an "Introduction to Proofs," covering terminologies, theorem statements, and both direct and indirect proof methods. Special attention is given to common mistakes in proofs, enhancing students' ability to critically assess mathematical arguments. The second segment delves into "Relations," examining their properties and methods of representation. Equivalence relations and partially ordered sets are explored, including the construction and interpretation of Hasse Diagrams and Lattices.

	The latter part of the course transitions into "Vector Calculus," wherestudents will study vector functions, derivatives of vector functions, arc length, unit tangent vectors, curvature, normal vectors of a curve, and directional derivatives. The course concludes with an exploration of vector integration, covering line integrals, vector fields, and their applications, including work, circulation, and flux.					
	Fundamental theorems such as path independence, conservative fields, and potential functions are introduced, with the exclusion of detailed proofs. Green's theorem in the plane and the divergence theorem are presented, emphasizing their statements and practical problem-solving.					
Semester	**3**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		4	0	0	0	**4**
Pre- requisites, If any	Vector Algebra					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Develop proficiency in constructing andunderstanding mathematical proofs.	A	1,2,4
2	Analyse and apply properties of relations and represent them effectively.	An	1,2
3	Explore vector functions, derivatives, arc length,and curvature of curves.	A	1,2,3
4	Strengthen critical thinking skills through practicalapplications of mathematical concepts	S	1,2,3,6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Relations and Proof Techniques**		**15**
	1.1	Terminologies and Understanding How Theorems are Stated	1	
	1.2	Direct Proofs	1, 4	
	1.3	Indirect Proofs	1, 4	
	1.4	Mistakes in Proofs	1, 4	
	1.5	Relations and their properties	2	
	1.6	Representation of Relations	2, 4	
	Text 1: Chapter 1 - Section: 1.7; Chapter 9 - Sections: 9.1 & 9.3			
2		**Equivalence relations and Partial ordering**		**15**
	2.1	Equivalence Relations	2, 4	
	2.2	Partially Ordered Set	2	
	2.3	Hasse Diagrams	2, 4	
	2.4	Lattices	2, 4	
	Text 1: Chapter 9 - Sections: 9.5 & 9.6			
3		**Vector Differentiation**		**15**
	3.1	Vector Algebra (Review), Vector functions,Derivatives of vector functions	3	
	3.2	Arc length and unit tangent vector	3	
	3.3	Curvature and normal vectors of a curve	3	
	3.4	Directional derivatives and Gradient vectors	3	

	Text 2: Chapter 13 - Sections: **13.1, 13.3, 13.4; Chapter 14 - Section**: **14.5**			
4		**Vector integration**		
	4.1	Line integrals	3, 4	
	4.2	Vector fields and line integrals: work,circulation and flux	3, 4	
	4.3	Path independence, conservative field and potential function (proofs of theoremsexcluded)	3	**15**
	4.4	Green's theorem in plane (statement andproblems only)	3, 4	
	4.5	Curl, Divergence in three dimensions,	3, 4	
	Text 2: Chapter 16 - Sections: **16.1 to 16.4,16.7(Curl only) & 16.8 (Divergence in three dimensions only)**			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose to encourage creativity and to develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching andLearning	**Classroom Procedure (Mode of transaction)**

<table>
<tr><td>Approach</td><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
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<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Rosen, Kenneth H. *Discrete Mathematics and Its Applications* (7th ed.). McGrawHill Publishing Co. New Delhi, 2013.
2. Thomas, George B., Jr., Maurice D. Weir**.** *Thomas' Calculus***.** 12th ed. Pearson, 2009**.**

SUGGESTED READINGS:

1. Griffiths, David J. *Introduction to Electromagnetism*. 4th ed. Cambridge UniversityPress, 2013.

2. Joyce, David D., and George C. Parker. *Vector Calculus and Its*

Applications. 4thed. Jones & Bartlett Publishers, 2022.
3. Schroeder, Glenn N. *Vector Analysis for Computer Graphics*. 3rd ed. A K Peters/CRCPress, 2017.
4. Tenenbaum, Morris T., and Harry Pollard. *Mathematics for the Nonmathematician:An Intuitive Approach.* 8th ed. Dover Publications, 2013.

ADVANCED READINGS:

1. Borceux, Francis. *Universal Algebra*. 2nd ed. Springer, 2003.
2. Farin, Susan E., and Wayne S. Sayle. *Vector Calculus*. 5th ed. Freeman, 2018.
3. Hayes, Martin H. C. *Introduction to Mathematical Proofs*. 2nd ed. Oxford UniversityPress, 2021.
4. Maddox, Randall. *A Transition to Advanced Mathematics*. 8th ed. AmericanMathematical Society, 2023.
5. Velleman, Daniel J. *How to Prove It: A Structured Approach*. 4th ed. Pearson, 2015.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Apply vector integration techniques to model projectile motion.
- Plot vector valued functions using graphing calculators and visualise concepts ofgradient and directional derivatives.
- Visualize position, velocity and acceleration of a moving object using sci-lab.
- Compute distance travelled and speed for motion along a space curve.
- Experience other commonly used proof methods like exhaustive prof, proof by cases,existence proof etc.
- Study Stoke's theorem and use it for evaluating circulation of vector functions.
- Discuss oriented surface and non-oriented surface with the help of a Mobius band.

Discipline Specific Elective – DSE

Art of Problem Solving with Python

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Art of Problem Solving with Python</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT3DSE200</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">Python Programming Language is a general purpose programming language which has applications in all fields of computer science. Data Science, Machine Learning, Artificial Intelligence are a few domains among them. This course provides the foundation of core Python Programming which can be applied to any field of Computer Science that uses Python as the programming language for solving the problems.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites,if any</td><td colspan="6">Basic Computer Knowledge</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, the student will be able to		

1	Understand and apply the variables and operators in Python.	U,A	1,2,3,4
2	Analyze and apply the required data structures namely numbers, strings, lists, tuple, set, dictionary along with the built-in functions.	A, An	1,4,5
3	Apply and find the solution for the problems using decision making statements and loops in Python	A	1,5,6
4	Analyze and apply functions with different types of arguments and modules for problem solving	A, An	1,2,3
5	Apply all the constructs and create solutions for problems	A, C	1,2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Introduction to Python, Features of Python	1	10
	1.2	How to Run Python	1	
	1.3	Identifiers, Reserved Keywords, Variables,	1	
	1.4	Input, Output and Import Functions	1	
	1.5	Operators- Arithmetic, Relational, Assignment, Logical, Membership and Identity Operators. Example Programs.	1	
		Problems (Practicum)	1	
	Text 1: Chapter 1			
2	2.1	Data Types – Numbers: Mathematical Functions, Trigonometric Functions, Random Number Functions. Example programs.	2	20
	2.2	Strings - String slicing, Built-in String formatting functions – len(), lower(), upper(), swapcase(), capitalize(),title(), lstrip(), rstrip(), strip(), replace(), count(), index(), startswith(), endswith(), isdecimal(), isalpha(), isalnum(), isdigit(), islower(), isupper(), isnumeric(), join(), split(). Example Programs.	2	

	2.3	Lists: Slicing, Built-in List Functions –len(), max(), min(), list(), map(). Built-in List Methods – append(), count(), remove(), index(), extend(), reverse(), insert(), sort(), pop(), clear(), copy(). Example Programs.	2	
	2.4	Tuple: Slicing, Built-in Tuple Functions – len(), max(), min(), tuple(). Example Programs	2	
	2.5	Set: Built-in Set functions – len(), max(), min(), sum(), sorted(), enumerate(), any(), all(). Built-in Set methods – add(), remove(), union(), update(), intersection(), intersection_update(), difference(), difference_update(), isdisjoint(), issubset(), issuperset(). Example Programs.	2	
	2.6	Dictionary: Properties of dictionary keys, Built-in Dictionary Functions – len(), Built-in Dictionary Methods – clear(), copy(), keys(), values(), items(), update(). Example Programs.	2	
	2.7	Mutable and Immutable objects, Data type conversion	2	
		Problems (Practicum)	2	
	Text 1: Chapter 2			

3	3.1	Decision Making: if statement, if….else statement, if...elif...else statement, Nested if statement. Example programs.	3	**25**
	3.2	Loops: for loop, range(), enumerate(), for loop with else, while loop, while loop with else statement. Example programs.	3	
	3.3	Nested Loops, Control Statements: break statement, continue statement, pass statement. Example programs.	3	
	3.4	Types of Loops - Infinite Loop, Loops with condition at the top, Loops with condition in the middle, Loops with condition at the bottom. Example programs.	3	
	3.5	List, Set and Dictionary Comprehensions. Example programs.	3	
		Problems (Practicum)	3	
	Text 1: Chapter 3			
4	4.1	Functions- Definition, Function calling, Functions returning more than one value. Example programs	4,5	**20**
	4.2	Function arguments- Required arguments, Keyword arguments, Default arguments, Variable-length arguments. Example programs	4,5	

	4.3	Anonymous (Lambda) Functions, Higher order functions. Example programs.	4,5	
	4.4	Modules - import Statement: import with renaming, from..import statement, import all names, creating modules. Example programs	4,5	
		Problems (Practicum)		
	Text 1: Chapter 4, Chapter 5			
5	**Teacher Specific Contents** Practical session, Field visit **This content will be evaluated internally**			

Practicum

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The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks
	B	**Semester End Examination (Written)**	

Assessment Types		Question Pattern [Maximum Time 2 Hours, Maximum Marks 70]			
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Jeeva Jose, Taming Python by Programming, Khanna Publishers, New Delhi, 2006.

SUGGESTED READINGS:

2. Charles Dierbach, Introduction to Computer Science using Python, Wiley, 2013
3. James Payne , Beginning Python: Using Python 2.6 and Python 3, Wiley India, 2010
4. Paul Gries , Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to
5. Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
6. Adesh Pandey, Programming Languages – Principles and Paradigms, Narosa, 2008

WEB RESOURCES:

- https://www.javatpoint.com/python-tutorial
- https://www.geeksforgeeks.org/python-programming-language-tutorial/
- https://www.w3schools.com/python/

- https://www.tutorialspoint.com/python/index.htm

Discipline Specific Elective – DSE

An invitation to Actuarial Mathematics

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B.Sc. Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">An invitation to Actuarial Mathematics</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT3DSE201</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">Introduces the students to provide basic grounding in basic financial mathematics like simple interest, compound interest, loan calculation and their simple applications. It familiarises the concepts- annuity, Stocks, dividends bonds, securities etc and the calculation associated with.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Probability, Money Math Fundamentals</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	To Provide Basic Grounding in FinancialMathematics	U	1,2,3,4,5
2	To Calculate various interests rates and budget.	A	1,2,3,4

3	To develop the skills, select suitable insurancesaccording to the circumstances	S	1,2,3,4,6
4	To handle various types of cash flows and ratefluctuations.	I	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Probabilities and Events	1	**15**
	1.2	Conditional Probabilities	1	
	1.3	Random Variable, Expected values andvariance.	1	
		Problems (Practicum)	1	
2	2.1	Simple Interest, Compound Interest,Continuously compounded interest	2	**20**
	2.2	Present values of future payments, rate of return	2	
	2.3	Continuously varying interest rates	2	
	2.4	Annuities, Calculating annuity premiums	2	
	2.5	Amortization of a debt, sinking funds, capitalbudgeting	2	
		Problems (Practicum)	**2**	
3	3.1	Risk and Insurance, Long Term and Short term insurance	3	**20**
	3.2	Life Insurance ,Automobile insurance,property insurance,	3	
	3.3	Indemnity principle, co-insurance principle	3	
	3.4	Stocks, dividends and bonds	3	

		Problems (Practicum)	3	
4	4.1	Deterministic Cash flows, internal rate of interests, modified internal interest rates, project choice	4	**20**
	4.2	Fixed income securities(bonds): bond price and yield, duration, convexity	4	
	4.3	Immunisation against interest rate fluctuations, short and forward rates	4	
	4.4	Term structure of interest rates, incorporatingterm structure into price/duration/convexity/immunization	4	
		Problems (Practicum)	**4**	

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Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Lecture, Teaching, Interactive instruction, Seminar, Group assignment,Library work and Group discussion.		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks

<table>
<tr><td rowspan="11">Assessment Types</td><td></td><td colspan="4">Quiz in any mode</td><td>5 Marks</td></tr>
<tr><td></td><td colspan="4">Assignment</td><td>5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="9"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to beanswered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

REFERANCES:

1. Sheldon Ross. *An Elementary Introduction to Mathematical Finance*.3rd Edition,Cambridge Advanced Sciences,2011
2. David Promislow. *Fundamentals of Actuarial Mathematics*. Wiley, 3rd Edition, 2015
3. Luenberger. *Investment Science* (Indian Edition), Oxford University Press, 2ndEdition, 2013.

SUGGESTED READINGS:

1. Robert Buchanan. *An Undergraduate Introduction to Financial Mathematics.*
2. Lerner and Zima. *Business Mathematics (Schaum's Outline Series).*
3. Brealy and Myers. *Corporate Finance*, Mc Graw Hill, 2023.
4. Sharpe, N.J. and Bailey Upper Saddler. River. *Investment* Prentice Hall, 1999.
5. Bodie, Kane and Marcus. *Investments*, McGraw-Hill Irwin, 2005.
6. P Romislow, S. D. *Fundamentals of Actuarial Mathematics.* John

Wiley & Sons,2014.

7. Bower, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A., & Nesbitt, C. J. *ActuarialMathematics*, 1997.

Discipline Specific Elective – DSE

Game Theory and Project Management

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B.Sc. Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Game Theory and Project Management</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT3DSE202</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course delves into the fundamental principles of game theory and project management, providing the students with a comprehensive understanding of strategic decision making, methods of solving games, techniques of project management and critical paths analysis. This course aims to equip students with the skills to strategically solve complex decision making scenarios and to successfully manage projectsin their future fields.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Basic Algebra, Calculus</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, the student will be able to		

1	Understand how optimal strategies are formulated inconflict and competitive environment	U	1,2
2	Apply various methods to select and execute variousoptimal strategies to win the game	E	1,2,3,4
3	Understand the significance of using PERT and CPMtechniques for project management	U	1,2
4	Determine critical path and floats associated with non- critical activities and events along with total projectcompletion time.	E	1,2,3,4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Game Theory: An Introduction**		**15**
	1.1	Game Theory: Introduction, Two-Person Zero-Sum Games	1	
	1.2	Pure Strategies: Games with Saddle Point	1	
	1.3	Mixed Strategies: Games without Saddle Point,Rules of Dominance	1	
		Problems (Practicum)	1	
	Text 1: Chapter 12 – Sections: 12.1 to 12.5			
2		**Game Theory: Solution Methods**		**20**
	2.1	Solution Methods: Algebraic Method	2	
	2.2	Arithmetic Method	2	
	2.3	Matrix Method	2	
	2.4	Graphical Method	2	

	2.5	Linear Programming Method	2	
		Problems (Practicum)	2	
	Text 1: Chapter 12 – Sections: 12.6.1 to 12.6.5			
3		**Fundamentals of Project Management**		**20**
	3.1	Project Management: Introduction, BasicDifference between PERT and CPM	3	
	3.2	Phases of Project Management	3	
	3.3	PERT/CPM Network Components andPrecedence Relationships	3	
	Text 1: Chapter 13 – Sections: 13.1 to 13.4			
4		**Critical Path Analysis**		**20**
	4.1	Critical Path Analysis: Forward Pass Method	4	
	4.2	Backward Pass Method	4	
	4.3	Float of an Activity and Event	4	
	4.4	Critical Path	4	
	Text 1: Chapter 13 – Sections: 13.5.1 to 13.5.4			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem Solving Skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**					
	Lecture, Teaching, Interactive instruction, Seminar, Assignment, andGroup discussion.					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			**Mark Distribution**	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern [Maximum Time 2 Hours, Maximum Marks 70]				
		Module	Part A	Part B	Part C	Total
			2 Marks	**6 Marks**	**10 Marks**	
		I	2	1	1	**4**
		II	2	3	2	**7**
		III	2	3	2	**7**
		IV	2	1	1	**4**
		Total no of questions	**8**	**8**	**6**	**22**
		Number of questions to be answered	**5**	**5**	**3**	**13**
		Total Marks	**10**	**30**	**30**	**70**

TEXT BOOK:

1. Sharma J.K. *Operations Research: Theory and Applications – 6th*

edition. TrinityPress an Impint of Laxmi Publications Pvt. 2016.

SUGGESTED READINGS:

1. Frederick S. Hillier., Gerald J Lieberman. *Introduction to Operations Research 10th edition.* McGraw Hill Education, 2015.
2. Taha, Hamdy A. *Operations Research: An Introduction – 8th edition*. PearsonEducation, 2007.
3. Kanti Swarup., Gupta ,,P.K., Man Mohan. *Operation Research.* Sultan Chand andSons, 2010.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Problem solving using the methods discussed in the module 1, 2 3 and 4

Discipline Specific Component (DSC B)

Essential Mathematics for Scientific Study

<table>
<tr><td></td><td colspan="5">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="5">B Sc Chemistry, B Sc Physics, B Sc Statistics etc.</td></tr>
<tr><td>Course Name</td><td colspan="5">Essential Mathematics for Scientific Study</td></tr>
<tr><td>Type of Course</td><td colspan="5">Discipline Specific Component (DSC B)</td></tr>
<tr><td>Course Code</td><td colspan="5">M24MT3DSC202</td></tr>
<tr><td>Course Level</td><td colspan="5">200</td></tr>
<tr><td>Course Summary</td><td colspan="5">This Mathematics minor course complements and enhances the undergraduate programmes on science disciplines such as Physics, Chemistry etc., by enabling the students to understand the concepts of complex numbers and analytic functions, to solve differential equations of different types, to identify different conic sections and its applications in possible areas and to determine unit tangent vector, principal normal vector, and curvature of different curves.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td>4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="5">Basic awareness of coordinate systems, vectors, functions, derivatives,and integrals</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Apply C-R equations to check the analyticity of complex functions	A	1,2,3,4
2	Solve equations in complex variables anddifferential equations	A	1,2,4,5,6
3	Identify conic sections from its equations and Visualize curves	E	1,2,3
4	Develop applications of mathematical concepts inscientific/real life problems	C	1,2,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Complex Functions**		20
	1.1	Complex Numbers, Sums and Products, Basic Algebraic Properties, moduli, conjugates, Exponential and Polar Forms, Products and Powers in Exponential form	1	
	1.2	Functions of Complex Variables, Separation into Real and Imaginary parts, Limits and Continuity	1	
	1.3	Derivatives, Analytic Function, Cauchy-Riemann Equations, Laplace Equation, HarmonicFunction	2	
		Problems (Practicum)	1, 2	
	Text 1: Chapter 1 – Sections: 1 to 7; Chapter 2 – Sections: 12,15,16,18 to 22, 24 to 26 Theorems – Statements Only			
2		**Differential Equations**		**18**
	2.1	Degree, Order, Solution of Differential Equations, Variable Separable method	2, 4	
	2.2	Exact Differential Equations	2, 4	
	2.3	Linear Differential Equations, Bernoulli's	2, 4	

		Equations		
		Problems (Practicum)	2, 4	
	Text 2: Chapter 1 – Sections: 1.1 to 1.5 Theorems – Statements Only			
3		**Analytic Geometry**		**17**
	3.1	Polar coordinates	3	
	3.2	Conic sections	3	
	3.3	Conic section in polar coordinates	3	
		Problems (Practicum)	3	
	Text 3: Chapter 11 – sections: 11.3,11.6 & 11.7Theorems – Statements Only			
4		**Vector Calculus**		**20**
	4.1	Curves in Space and tangents, Velocity andAcceleration, Arc length in space	4	
	4.2	Curvature and Normal vectors of a curve	4	
	4.3	Directional derivatives and gradient vectors	4	
		Problems (Practicum)	4	
	Text 3: Chapter 13 – Sections: 13.1,13.3,13.4; Chapter 14 – Section: 14.5Theorems – Statements Only			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

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It's purpose is to encourage creativity and develop Problem solving skills.

The practicum component is to be done in the classroom under the strict guidance of the teachers.

A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching andLearning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Direct Instruction, Brainstorming Lecture, Explicit Teaching, Active Co-operative Learning,</td></tr>
<tr><td rowspan="15">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
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<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. James Ward Brown, Ruel V. Churchill. *Complex Variables and Applications*, *EighthEdition*, McGraw Hill, *2009*
2. Simmons, G.F., Krantz, S.G. *Differential Equations*, Tata

McGraw Hill-NewDelhi, 2007.
3. Thomas, George B Jr. *Thomas' Calculus, Twelfth Edition*, Pearson, 2010SUGGESTED

READINGS:

1. Grewal, B. S., *Higher Engineering Mathematics, 44th Edition*, Khanna Publishers,2021.
2. Anton, H., Bivens, Devis. *Calculus, tenth Edition*, Wiley India.
3. Kreyszig,E. *Advanced Engineering Mathematics*, Wiley, India.
4. Siddiqi, A.H., Manchanada, P. *A first course in Differential Equations*, Mc Millan.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Proofs of theorems from module 1, 2, 3 & 4
- Solution of equations in Complex variables, Regions in the Complex plane
- Homogeneous Differential equations, Integrating Factors of Differential Equations
- Visualization of curves and conic section, Obtaining Points of farthest and closestapproach of Planets/ Satellites
- Integration in vector fields, Finding Work done, Flow, circulation and flux
- Text 1-Chapter 1 (Roots of complex numbers, Regions in complex plane)
- Text 2 – Chapter 1 (Homogeneous Differential Equations, Integrating factors)
- Text 3 – Chapter 16 (Line integrals, Work, Circulation and Flux)

Discipline Specific Component (DSC B)

Mathematics for Business and Economics

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**BA Economics and B Com**					
Course Name	**Mathematics for Business and Economics**					
Type of Course	**Discipline Specific Component (DSC B)**					
Course Code	**M24MT3DSC203**					
Course Level	**200**					
Course Summary	Mathematical methods and theories applicable in economics and business to analyse real life problems are included in the course. First module provides an understanding of the way in which financial calculations are worked out. Second module deals with different methods of solving systems of equations and the many varied applications of such systems to business and economics. Optimization of functions using their derivatives is included in the third module. Linear programming is helpful in business and economics where it is often necessary to optimize a profit or cost function subject to several inequality constraints. The graphic approach for maximization and minimization linear programming problems is also illustrated. Module four deals with the applications of calculus in economics and business.					
Semester	**3**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites,If any	Graphing functions, Basics of differential and integral Calculus, Multi- variable functions and partial differentiation, Percentage calculation,Basics of logarithmic and exponential functions					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	understand the difference between simple and compound interest	U	1,2,3
2	evaluate a geometric series and calculate the totalinvestment obtained from a regular savings plan.	E	1,2,3,4,5
3	use net present values to appraise investment projects and calculate the internal rate of return, thepresent value of an annuity	A	1,2,3,4
4	understand functions, classical optimizationtechniques and marginal concepts in economics	U	1,2
5	analyse the real-life problems in business and economics and to model it mathematically	A, An, C	1,2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Mathematics of Finance**		
	1.1	Compound Interest	1	**15**
	1.2	Geometric Series	2	

	1.3	Investment Appraisal	2, 3	
		Problems (Practicum)	1,2,3	
	Text 2: Chapter 3 – Sections: 3.2 to 3.4			
2		**Mathematical Economics**		
	2.1	Introduction to System of Equations	3	
	2.2	Graphical Solutions	3	
	2.3	Supply-and-Demand Analysis	3, 4	
	2.4	Break-Even Analysis	3, 4	**20**
	2.5	Elimination and Substitution Methods	3, 5	
	2.6	Income Determination Models	3, 5	
	2.7	IS-LM Analysis	3	
		Problems (Practicum)	3, 4, 5	
	Text 1: Chapter 4 – Sections: 4.1 to 4.7			
3		**Optimization Techniques**		
	3.1	Use of Graphs in LPP, Maximization UsingGraphs	4, 5	
	3.2	The Extreme-Point Theorem, MinimizationUsing Graphs	4, 5	
	3.3	Optimization of Functions, The Successive-Derivative Test	4, 5	**25**
	3.4	Marginal Concepts in Economics	4, 5	
	3.5	Optimizing Economic Functions for Business	4, 5	
	3.6	Relationship Among Total, Marginal, andAverage Functions	4, 5	
		Problems (Practicum)	4, 5	
	Text 1: Chapter 7 – Sections: 7.1 to 7.4; Chapter 10 – Sections: 10.6 to 10.10			

4		**Applications of Mathematics in Economicsand Business**		
	4.1	Functions of Several Independent Variables	3, 4	
	4.2	Constrained Optimization problems withLagrange Multipliers	3, 4	**15**
	4.2	Applications of definite integral in consumersand producers surplus	3, 4, 5	
		Problems (Practicum)	3, 4, 5	
	Text 1: Chapter 12 – Section: 12.11; Chapter 13 – Sections: 13.1 & 13.6			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
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Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**	
	Direct Instruction, Brain Storming Approach, Interactive instruction, GroupDiscussion, Presentation by Individual Student/ Group Representatives	
	MODE OF ASSESSMENT	
	A	**Continuous Comprehensive Assessment (CCA)**

<table>
<tr><td rowspan="11">Assessment Types</td><td rowspan="4"></td><td colspan="4">Components</td><td>Mark Distribution</td></tr>
<tr><td colspan="4">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="4">Quiz in any mode</td><td>5 Marks</td></tr>
<tr><td colspan="4">Assignment</td><td>5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="7"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td>Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td></td><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Edward T Dowling, *Mathematical Methods for Business and Economics*, Schaum'sOutline Series, McGraw Hill, 2009.
2. Ian Jacques, *Mathematics for Economics and Business*, 5th Edition, Prentice Hall,2006.

SUGGESTED READINGS:

1. Taro Yamne, *Mathematics for Economists-An elementary survey,* Prentice -Hall, Inc.
2. Robert Brechner, *Contemporary Mathematics for Business and Consumers,* Fifth Edition
3. Das, N. G., Das, J K. *Business Mathematics and Statistics*, Tata McGraw-Hill, 2012.
4. Martin Anthony, Norman Biggs, *Mathematics for economics and finance Methods andModelling,* Cambridge University Press, 2012.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Application mathematics in economics and business using spreadsheets

Mathematics of Nature and Art

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Mathematics of Nature and Art**					
Type of Course	**Foundation Component - MDC**					
Course Code	**M24MT3MDC200**					
Course Level	**200**					
Course Summary	The course explores Fibonacci numbers' diverse applications in nature, arts, science, and the significance of the golden ratio and continued fractions in various contexts. It helps to understand their role in natural phenomena, artistic expressions, mathematical principles, and practical applications across disciplines.					
Semester	**3**	**Credits**			**3**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	0	0	**3**
Pre- requisites, If any	Nil					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Understand Fibonacci and Lucas numbers, theirproperties, and applications in natural phenomena and diverse real-world scenarios.	U, A	1,2,5,6
2	Analyze and apply Fibonacci's impact on artistic expressions, scientific realms, andinterdisciplinary connections across various fields.	K, U, A	1,2,3,4
3	Comprehend the significance of the golden ratio, its geometric interpretations, applications in human anatomy, arts and mathematical constructions.	K, U, A	1,2,3,4,5
4	Understand and apply the concepts of finite and infinite continued fractions, convergence, recursive definitions, and their implications in solving problems.	K, U, A	1,4,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Fibonacci Numbers in Nature, Arts & Science**		
	1.1	The rabbit problem, Fibonacci numbers, Recursive definition, Lucas numbers, Fibonacci and Lucas primes.	1	
	1.2	Different types of Fibonacci and Lucas numbers.	1	
		Fibonacci numbers in nature: Fibonacci and the earth, Fibonacci and flowers, Fibonacci and trees,		**16**

	1.3	Fibonacci and sunflowers, Fibonacci - pinecones, artichokes and pineapples, Fibonacci and bees, Fibonacci and subsets.	1	
	1.4	Fibonacci and atoms, Fibonacci and reflections. Fibonacci - paraffins and cycloparaffins,Fibonacci and music, Fibonacci and poetry.	2	
	1.5	Fibonacci and compositions with 1's and 2's, Fibonacci and neurophysiology. (Theorems 3.1,3.2,3.3- statement only)	2	
	Text 1: Chapters 2 & 3 (Relevant sections only)			
2		**Fibonacci Numbers in Arts and Science**		
	2.1	The golden ratio, Mean proportional, A geometric interpretation.	3	
	2.2	Ruler and compass construction, Euler construction. Generation by Newton's method.	3	
	2.3	The golden ratio revisited: Golden ratio and human body, Mexican Pyramids, Differential equations, Golden ratio and centroids of circles.	3	
	Text 1: Chapters 20 & 21 (Relevant sections only)			
3		**Continued Fractions**		
	3.1	Finite continued fractions, Convergents of a continued fraction.	4	
	3.2	Recursive definition, Infinite continued fraction.	4	
	3.3	An infinite continued fraction for – , Pell's equation.	4	
	Text 1: Chapter 27			

4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture and Tutorial</td></tr>
<tr><td></td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td rowspan="12">Assessment Types</td><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="3"></td><td colspan="4">Components</td><td>Mark Distribution</td></tr>
<tr><td colspan="4">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="4">Assignment/Quiz</td><td>5 Marks</td></tr>
<tr><td rowspan="9">B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td colspan="5">Question Pattern
[Maximum Time 90 Minutes, Maximum Marks 50]</td></tr>
<tr><td>Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td></td><td>1 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>4</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td>II</td><td>4</td><td>2</td><td>2</td><td>8</td></tr>
<tr><td>III</td><td>4</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>6</td><td>4</td><td>22</td></tr>
<tr><td>Number of questions to beanswered</td><td>10</td><td>4</td><td>2</td><td>16</td></tr>
<tr><td>Total Marks</td><td>10</td><td>20</td><td>20</td><td>50</td></tr>
</table>

TEXT BOOK:

1. Thomas Koshy. *Fibonacci and Lucas numbers with applications*, John Wiley & Sons,Inc, 2001.

SUGGESTED READINGS:

1. Richard A Dunlap. *The Golden Ratio and Fibonacci Numbers*, World ScientificPublishing Co. Pt. Ltd.
2. Mario Livio. *The Golden Ratio*, Broadway Books, New York.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Fibonacci and male bees.
- Fibonacci and sewage treatment.
- Fibonacci and the Balmer series.
- Proofs of Theorems 3.1, 3.2 and 3.3.
- Fibonacci and electrical networks.
- Violin and golden triangle.
- Golden ratio by origami.

Gattei's discovery of golden ratio.

Mastering Problem Solving through Vedic Mathematics

<table>
<tr><td></td><td colspan="5">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="5">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="5">Mastering Problem Solving through Vedic Mathematics</td></tr>
<tr><td>Type of Course</td><td colspan="5">Foundation Component - VAC</td></tr>
<tr><td>Course Code</td><td colspan="5">M24MT3VAC200</td></tr>
<tr><td>Course Level</td><td colspan="5">200</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course provides a comprehensive exploration of Vedic Mathematics, a traditional Indian system known for its speed and efficiency in problem-solving. Through a structured four-unit approach, students will understand the importance of Vedic Mathematics, advanced arithmetic techniques, root calculations, and applications in algebra, empowering them with valuable tools for quick and accurate problem-solving.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="2">Credits</td><td colspan="2">3</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="5">Nil</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course,the student will be able to		

1	Attain proficiency in mental calculation techniques for addition, subtraction, multiplication, and division, fostering quicker andmore accurate problem-solving.	S	1,2,3,4,5,6
2	Apply Vedic Mathematics to solve a diverse range of mathematical problems, including algebraic expressions and equations, showcasing versatility in problem-solving.	A	1,2,3,4
3	Gain confidence and readiness to tackle competitive exams by mastering quantitative aptitude using Vedic Mathematics techniques, ensuring a competitive edge in various examinations.	A, An	1,2,3
4	Apply Vedic Mathematics skills to real-world scenarios, including ratio and proportions, percentage calculations, profit and loss analysis, and interest calculations.	A	1,2,3,4
5	Apply Vedic Mathematics principles to algebraicexpressions, including efficient multiplication of polynomials and solving systems of linearequations.	A, An	1,2,3,4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Foundations of Vedic Mathematics**		**12**
	1.1	Overview of Vedic Mathematics- History and its importance, Vedic Sutras and sub- sutras	1	
	1.2	Addition : Ekadhikena Purvena	1, 2	
	1.3	Subtraction :Nikhilam NavatascaramamDasatah, Digit Separator Method	1, 2	

	1.4	Multiplication : Ekanyunena Purvena, Multiplication of numbers having two-digits and three-digits using Urdhva Tiryagbhyam, Multiplication by series of 1's and 9's	1, 2	
	1.5	Division : Urdhva – Tiryakgbhyam	1, 2,5	
	Text 1: Specified sections from Chapters 1 to 4 & 6			
2		**Advanced Arithmetic Techniques and itsApplications**		**19**
	2.1	Squares: Squares of numbers up to three-digits using Ekadhikena Purvena, Dwanda yoga	1,2,5	
	2.2	Square roots : Duplex Method	1, 2, 5	
	2.3	Cubes: Cubes of two-digit numbers usingNikhilam	1,2,5	
	2.4	Cube roots : Cube Root of a number havingless than 7 digits using Beejank	1, 2, 5	
	2.5	Divisibility and simple Osculators	1,2,5	
	2.6	Applications: Ratio and proportions, Percentage, Profit and Loss, Simple interest, Compound Interest	3, 4, 5	
	Text 1: Specified sections from Chapter 7, 8, 10 & 11 **Text 2: Chapter 29** **Text 3: Chapter 18, 20, 23, 24 & 25**			
3		**Algebraic Multiplication and EquationSolving**		**14**
	3.1	Multiplication in algebra : Multiplication ofpolynomials of the form ax+by, ax^2+bx+c	1,3	
	3.2	Simple Equations: Solving simple equationsin one variable	1,3	

	3.3	Simultaneous Simple Equations : Solution of system of linear equations in two variables	1,3	
	Text 1: Specified sections from Chapter 5 **Text 2: Specified sections from Chapters 11, 12, 13 & 15**			
4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**					
	Interactive Lectures, Conduct Regular Practical Workshops Focusing on Mental Calculation Techniques and Vedic Mathematics Applications, ProvideHands-on Exercises with Immediate Feedback to Reinforce Learning.					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			**Mark Distribution**	
		Teacher Specific Content			20 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 90 Minutes, Maximum Marks 50]**				
		Module	Part A **1 Marks**	Part B **5 Marks**	Part C **10 Marks**	Total
		I	4	2	1	**7**
		II	4	2	2	**8**
		III	4	2	1	**7**
		Total no of questions	**12**	**6**	**4**	**22**
		Number of questions to	**10**	**4**	**2**	**16**

		beanswered				
		Total Marks	**10**	**20**	**20**	**50**

TEXT BOOKS:

1. Thakur, Rajesh Kumar. *The Essentials of Vedic Mathematics*, Rupa Publications IndiaPvt Ltd, 2013.
2. Bharati Krishna Tirthaji. *Vedic Mathematics*: *Sixteen Simple Mathematical formulae fromthe Vedas*, Motilal Banarsidass, 1981.
3. Tyra, M. *Magical Book On Quicker Maths*, BSC Publishing Co. Pvt. Ltd, 5th Edition,2018.

SUGGESTED READINGS:

1. Singhal, Vandana. *Vedic Mathematics for all ages: A Beginner's Guide*, Motilal Banarsidass, 2014.
2. Patankar, U. S., S. M. Patankar. *Elements of Vedic Mathematics*, TTU Press, 2018.

ADVANCED READING:

1. Dattoli, Giuseppe, Marcello Artioli, Silvia Licciardi. *Vedic Mathematics: A Mathematical Tale from the Ancient Veda to Modern Times*, World Scientific Publishing Co Pte Ltd, 2021.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Relevant topics can be selected from Textbook 3

Semester 4

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /week			
					L	T	P	O
M24MT4DSC200	Matrix Algebra and Number Theory	Discipline Specific Component- DSC A	4	5	3	-	2	-
M24MT4DSC201	Fundamentals of Analysis	Discipline Specific Component- DSC A	4	4	4	-	-	-
M24MT4DSE200	Data Processing and Visualization (S)	Discipline Specific Elective - DSE	4	5	3	-	2	-
M24MT4DSE201	Mathematical Modelling	Discipline Specific Elective - DSE	4	5	3	-	2	-
M24MT4DSE202	Transforms and Fourier Series	Discipline Specific Elective - DSE	4	5	3	-	2	-
M24MT4DSC202	Essential Mathematics for Science	Discipline Specific Component - DSC B	4	5	3	-	2	-
M24MT4DSC203	Computational Methods for Business and Economics	Discipline Specific Component - DSC B	4	5	3	-	2	-
M24MT4VAC200	Business Mathematics	Foundation Component - VAC	3	3	3	-	-	-
M24MT4SEC200	Document Preparationusing LaTeX	Foundation Component - SEC	3	3	3	-	-	-
M24MT4INT200	Internship	-	2	-	-	-	-	-

Discipline Specific Component (DSC A)

Matrix Algebra and Number Theory

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Matrix Algebra and Number Theory</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT4DSC200</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course provides an introduction to the fundamental concepts and techniques of matrix algebra and number theory. The first two modules deal with matrix algebra and solutions of systems of linear equations. Third module starts with basics for theory of numbers which will be followed by the Division algorithm, Euclidean algorithm etc. Fourth Module involves some classical theorems by Fermat, Wilson and Euler.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Basic idea about matrices, integers and primes.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, the student will be able to		
1	Demonstrate a thorough understanding of the basicconcepts of matrix algebra and formulate systems of linear equations into matrices	U	1, 3,4,5,6
2	Analyze the properties of systems of linear equationsand their solutions	An	1,2,3
3	Demonstrate understanding of fundamental concepts in number theory, including congruence, divisibility, GCD etc	U	1,2,3
4	Analyze Fermat's Little Theorem, understanding itssignificance and implications	An	1,2,3,4
5	Apply computational software and tools in matrix computations and also concepts of number theory.	A	1,2,3,4,5,6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill(S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Matrix Operations	1	20
	1.2	Properties of matrix operations	1	
	1.3	Different types of matrices	1	
	1.4	Matrix representation of system of linear equations	2	
	1.5	Elementary row transformations and elementarymatrices	2	

	1.6	Gaussian Elimination, Row-echelon form, Hermiteform	2	
		Problems (Practicum)	1, 2	
	Text 1: Chapter 1; Chapter 3 [upto Exercise 3.10 -Theorems (Statement only)of all theorems in Chapter 3]			
2	2.1	Linear combination and independence/dependence ofrows and columns of matrices	1, 2	**15**
	2.2	Row equivalent matrices	1, 2	
	2.3	Row rank, column rank and rank of a matrix	1, 2	
	2.4	Normal form and equivalent matrices	1, 2, 5	
	2.5	Consistency of system of linear equations	1, 2, 5	
	2.6	Invertible Matrices	1, 2, 5	
		Problems (Practicum)	1, 2, 5	
	Text 1: Remaining portions of Chapter 3 and Chapter 4 [Theorems (Statement only) and their applications]			
3	3.1	The Division Algorithm	3	**20**
	3.2	The Greatest Common Divisor	3, 4	
	3.3	The Euclidean Algorithm	3	
	3.4	The Fundamental Theorem of Arithmetic	3, 4	
	3.5	The Sieve of Eratosthenes	3	
		Problems (Practicum)	3, 4	
	Text 2: Chapter 2 – Sections: 2.2 (Statements and applications only), 2.3 [Theorem 2.3 and 2.4(Statements only)], 2.4 [Theorem 2.7 and 2.8(Statementsonly and applications)]; Chapter 3 - Sections: 3.1 & 3.2 (Theorem 3.4 only)			
4	4.1	Basic Properties of Congruence	3, 4, 5	**20**
	4.2	Fermat's Theorem and pseudoprimes	4, 5	

	4.3	Wilson's Theorem	4, 5
	4.4	Euler's Phi Function and Theorem	3, 5
		Problems (Practicum)	3,4,5
	Text 2: Chapter 4 – section: 4.2; Chapter 5 – Sections: 5.2 (Up to Theorem 5.2), 5.3 (Up to Theorem 5.5); Chapter 7 – Sections: 7.2 (Theorem 7.2-Statement only and applications) & 7.3		
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity anddevelop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**		
	Lectures, Tutorials, Interactive Sessions, Blended Learning		
Assessment	**MODE OF ASSESSMENT**		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**

<table>
<tr><td></td><td></td><td colspan="3">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td rowspan="4">Types</td><td rowspan="2"></td><td colspan="3">Quiz in any mode</td><td>5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td>5 Marks</td></tr>
<tr><td>B</td><td colspan="4">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Blyth, T. S., and E. F. Robertson. *Basic linear algebra*. Springer, 2007**.**
2. Burton, David M.. *Elementary number theory (7th ed.).* McGraw-Hill Education,2017.

SUGGESTED READINGS:

1. Strang, Gilbert. *Introduction to linear algebra (5th ed.)*. Wellesley-Cambridge Press,2016.
2. Lipschutz, S., Lipson, M.. *Schaum's outline of theory and problems of linear algebra(4th ed*.). McGraw-Hill.
3. Kumaresan, S. *Linear Algebra: A Geometric Approach.* PHI Learning.,2015.
4. Bronston, T. A., Costa, A. C. R. . *Linear algebra*: *An introduction (4th ed*.).Academic Press, 2013.

ADVANCED READINGS:

1. Apostol, T. M. . *An Introduction to Analytic Number Theory* (2nd ed.). Springer,1976.

2. Niven, I., Zuckerman, H. S., Montgomery, H. L. *An Introduction to Number Theory* (5th ed.). Wiley, 1991.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Proofs of theorems in Chapter 3 (up to exercise 3.10) and Chapter 4
- Use of computational software or tools (like Python, Sage math etc.) to perform thematrix operations in the modules 1 and 2
- Illustrate the technique of Sieve of Eratosthenes for finding all primes below a giveninteger (Chapter 3-Sec. 3.2 of Textbook 2)
- Apply Congruence relation to encrypt and decrypt a message using Caesar Cipher andVigenere's approach. (Relevant Sections of Chapter 10 of Textbook 2)
- Proofs of theorems 2.3 and 2.4 of Textbook 2.

Discipline Specific Component (DSC A)
Fundamentals of Analysis

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Fundamentals of Analysis</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT4DSC201</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course covers elementary properties of real and complex numbers, with a focus on analytic functions and various mathematical functions. Practical applications and problem-solving skills are emphasized throughout. The course provides an in-depth review of complex numbers, exploring their fundamental characteristics, exponential representations, and geometric importance. It delves into functions of complex variables, presenting the Cauchy-Riemann equations as a means of identifying analytic functions. The conclusion includes a comprehensive discussion of special functions of complex variables, such as inverse trigonometric and hyperbolic functions, as well as
exponential, logarithmic, trigonometric, and hyperbolic functions.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Basic Set theory and Calculus</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	To understand the basic principles of set theory, including definitions of finite and infinite sets, cardinality, and operations on sets.	U	1,2,3
2	Demonstrate a comprehensive understanding of the real numbers as a complete ordered field, distinguishing their properties from those of other algebraic structures with similarities to real numbers.	A	1,2,3,4,5
3	Analyze the concept of completeness property in real numbers and apply the supremum property in mathematical analysis and problem-solving.	An	1,2,3,4
4	Understand the basic properties of complex plane,its geometrical dimensions and complex functions	U	1,2,4,5
5	Categorise the basic properties of some elementaryfunctions of complex variables.	An	2,4,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Graphical visualization of ElementaryFunctions using *Geogebra/ Desmos*	1	**15**
	1.2	Finite and Infinite Sets.	1	
	1.3	The Algebraic and Order Properties of R.	2	
	1.4	Absolute Value and the Real Line.	2	

	Text 1: Chapter 1 - Section: 1.3 (Concepts, statements of the theorems,informal proofs and problems only); Chapter 2 - Sections: 2.1 & 2.2.			
2	2.1	The Completeness property of R	2	**15**
	2.2	Applications of supremum property	2	
	2.3	Intervals	2	
	Text 1: Chapter 2 - Sections: 2.3, 2.4 (Theorems 2.4.7 – Statement only), 2.5 (Concepts, statements of the theorems and problems only).			
3	3.1	Basic Properties of Complex Numbers	4, 5	**15**
	3.2	Exponential form of Complex Numbers	4, 5	
	3.3	Roots of Complex Numbers	4, 5	
	3.4	Regions in the complex Plane	4, 5	
	3.5	Functions of the complex Variables	4, 5	
	3.6	Limits and Continuity	4, 5	
	3.7	Differentiation of Complex functions and CREquations	4, 5	
	3.8	Analytic and Harmonic functions	4, 5	
	Text 2: Sections: 1 to 12,15,16,18 to 22,24 to 26 (Concepts, statements ofthe theorems and problems only from sections 16, 21 and 22)			
4	4.1	Exponential functions	5	**15**
	4.2	Logarithmic functions	5	
	4.3	Trigonometric and Hyperbolic functions	5	
	4.4	Inverse Trigonometric and Hyperbolicfunctions	5	
	Text 2: Sections: 29 to 32, 34 to 36			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**ts purpose is to encourage creativity and develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching andLearning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="5"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td>Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td><td></td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td></td><td></td><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
</table>

		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Bartle, Robert G., Sherbert, Donald R. *Introduction to Real Analysis (4th Edition),*Wiley Internationals, 2000.
2. Brown, James Ward., Churchil, Ruel V. *Complex Variables and Applications* *(8th Edition)*

SUGGESTED READINGS:

1. Denlinger, Charles. *Elements of real analysis*. Jones & Bartlett Learning, 2011.
2. Abbott, Stephen. *Understanding analysis*. springer publication, 2015.
3. Ghorpade, Sudhir R., and Balmohan Vishnu Limaye. *A course in calculus and realanalysis*. New York: Springer, 2006.
4. Kumar, Ajit, Kumaresan, S. *A basic course in real analysis*. CRC press, 2014.
5. Ponnusamy, S., Herb Silverman. *Complex variables with applications*. SpringerScience & Business Media, 2007.
6. Krantz, Steven G. *Complex Variables: a physical approach with applications andMATLAB.* CRC Press, 2007.
7. Kasana, Harvir Singh. *Complex variables: theory and applications*. PHI Learning Pvt.Ltd., 2005.
8. Zill, Dennis G., and Patrick D. Shanahan. *Complex analysis: A first course withapplications*. Jones & Bartlett Publishers, 2013.
9. Choudhary, B. *The elements of complex analysis*. New Age International, 1993.

ADVANCED READINGS:

1. Howie, John M. *Real analysis*. Springer Science & Business Media, 2006.

2. Rudin, Walter. *Principles of mathematical analysis*. Vol. 3. New York: McGraw-hill,1976.

3. Royden, Halsey Lawrence, and Patrick Fitzpatrick. *Real analysis*. Vol. 2. New York:Macmillan, 1968.

4. Saff, E. B., Snider, A. D. *Fundamentals of Complex Analysis with Applications toEngineering, Science and Mathematics*, (2002).

5. Jeffrey, Alan. *Complex analysis and applications*. CRC Press, 2005.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Principle of strong mathematical induction.
- Well ordering property
- Check whether C satisfies the completeness property.
- Binary representation and decimal representation of real numbers.
- Plot and analyse complex functions using available software.
- Applications of complex numbers and complex functions in different areas.
- Studies on multi valued complex functions
- Formal proofs of theorems in section 1.3
- Proof of theorem 2.4.7
- Proof of theorems in section 2.5

Discipline Specific Elective – DSE

Data Processing and Visualization using Python

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Data Processing and Visualization using Python</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT4DSE200</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">Data processing and visualization are two core components in Data Science. This course provides a strong foundation in data processing and various visualization tools. It provides a deep knowledge in pandas which is a built-in library in Python for data processing. Data visualization is done using matplotlib and seaborn which are the built-in libraries in Python for plotting various graphs. This course helps to understand the nature of data, processing data for removing noise and to visualize the data to understand the trends and patterns in data.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="2">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites,If any</td><td colspan="6"></td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, the student will be able to		

1	Understand different types of data and introduction to pandas dataframe.	U	1,2,3
2	Understand and apply the functions in dataframes in pandas.	U, A	1,3,5
3	Understand, apply and analyse various graphs in matplotlib	U, A, An	1,2,3,4,5,6
4	Understand, apply and analyse various graphs in seaborn	U, A, An	1, 3
5	Apply, analyze and evaluate various visualization tools based on case studies.	A, An, E	1,5,6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Introduction, Types of data- Structured data-continuous data, discrete data, categorical data, nominal data, ordinal data, ratio-scaled (exponential) data.	1	**10**
	1.2	Introduction to Pandas, data structures –Series, DataFrame,	1	
	1.3	Reading from csv files, writing back to csv files	1	
	1.4	Reading from Excel files, writing back to Excel files.	1	
		Problems (Practicum)		
	Text 1: Chapter 1, Chapter 2			
2	2.1	Need for data cleaning, Examples for data cleaning	2	**15**
	2.2	Extracting data using loc() and iloc() functions, descriptive statistics functions –count(), sum(), mean(), median(), mode(), var(), std(), min(), max(), abs(), prod(), cumsum(), cumprod()	2	
	2.3	Inserting columns into dataframes, deleting rows and columns from dataframes	2	
	2.4	Concatenating data frames, merging/joining dataframes.	2	

	2.5	Group by and aggregate functions	2	
		Problems (Practicum)	2	
	Text 1: Chapter 3, Chapter 4			

3	3.1	Introduction to matplotlib,	3,5	**25**
	3.2	Bar chart, Grouped bar chart, Stacked bar chart	3,5	
	3.3	Histogram, Line chart, Pie chart	3,5	
	3.4	Scatterplot, Bubble plot	3,5	
	3.5	Box plot, Violin plot	3,5	
	3.6	Heatmap, Stem plot, Polar plot	3,5	
	3.7	Quiver plot, Stream plot Contour plot, Triangulation plot	3,5	
	Text 1: Chapter 5			
4	4.1	Introduction to seaborn, matplotlib vs. seaborn	4,5	**25**
	4.2	Bar chart, Grouped bar chart, Histogram, Line chart	4,5	
	4.3	Scatter plot, Box plot, Violin plot	4,5	
	4.4	Heatmap, Regression plot, LM plot	4,5	
	4.5	KDE plot, Cluster plot, Facet grid	4,5	
	4.6	Pair plot, Joint plot, Gantt Chart	4,5	
	4.7	Correlogram, Q-Q plot	4,5	
	Text 1: Chapter 6			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. as specified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem Solving Skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

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<tr><td colspan="6"></td></tr>
<tr><td rowspan="15">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="7"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
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<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
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		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Jeeva Jose, Data Analysis and Visualization using Python, Khanna Publishers, New Delhi, 2024.

SUGGESTED READINGS:

7. Gypsy Nandi, Rupam Kumar Sharma, Data Science Fundamentals and Practical Approaches, BPB publications, 2020.
8. Vishal Goyal, Monika Bansal, Munish Jindal, Harmandeep Kaur, Data Science using Python: A Step-by-Step Practical Approach for Beginners, DPS Publishing House, 2022.
9. B. SrikanthSwarajya Lakshmi V PapineniSyed Khasim, Fundamentals of Data Science, Walnut Publication, 2022.

Web Resources:

- https://intellipaat.com/blog/tutorial/data-science-tutorial/
- https://www.tutorialspoint.com/matplotlib/index.htm
- https://www.javatpoint.com/python-seaborn-library

Discipline Specific Elective – DSE
Mathematical Modelling

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Mathematical Modelling**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT4DSE201**					
Course Level	**200**					
Course Summary	Mathematical modelling is a process that uses math concepts to explain systems, functions and events. Nearly any industry can benefit from mathematical modelling, but it's most commonly used in areas such as engineering, computer science, social science and natural science. Mathematical modelling is described as conversion activity of a real problem in a mathematical form. Modelling involves to formulate thereal-life situations or to convert the problems in mathematical explanations to a real or believable situation.					
Semester	**4**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites,If any	Basic Calculus and Differential Equations					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Get an insight into different Mathematicaltechniques that are applied in real life.	U	1,2,3
2	Understand the use First Order Differentialequation to create mathematical models of real life.	U	1,2,5,6
3	Solve Mathematical Modelling of geometricalproblems using first order differential equation.	A	1,2,3,4,5
4	Solve Mathematical Modelling of populationproblems using first order differential equation. Use Second Order Differential equation to createmathematical models of real life.	U, A	1,2,3,4
5	Solve Mathematical Modelling of trajectory relatedproblems using second order differential equation.	A	1,2,3,4,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Simple Situations Requiring MathematicalModelling	1	**15**
	1.2	The technique of Mathematical Modelling	1	
	1.3	Classification of Mathematical Models	1	
	1.4	Some Characteristics of Mathematical Models	1	
	1.5	Modelling through Geometry, A	1	
		Problems (Practicum)		
	Text 1: Chapter 1 - Sections: 1.1 to 1.8			
	2.1	Modelling through Differential Equations	2	
	2.2	Linear Growth and Decay Models	2	

2	2.3	Non-linear Growth and Decay Models	2	**20**
	2.4	Compartment Models	2	
	2.5	Mathematical Modelling in Dynamics through Ordinary Differential Equations of the first order.	3	
		Problems (Practicum)		
	Text 1: Chapter 2 -Sections: 2.1 to 2.5			
3	3.1	Mathematical Modelling in PopulationDynamics	4	**20**
	3.2	Mathematical Modelling in Epidemics	4	
	3.3	Compartment Models	4	
	3.4	Economics Related Models	4	
		Problems (Practicum)		
	Text 1: Chapter 3 - Sections: 3.1 to 3.4			
4	4.1	Mathematical Modelling of Planetary Motion	4	**20**
	4.2	Mathematical Modelling of Circular motionand Motion of Satellites	4	
	4.3	Mathematical Modelling through LinearDifferential Equations of Second Order	5	
	4.4	Miscellaneous Problems	5	
		Problems (Practicum)		
	Text 1: Chapter 4 - Sections: 4.1 to 4.4.			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
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<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
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<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="6"></td><td rowspan="6"></td><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
</table>

		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Kapur, J. N. *Mathematical Modelling 2nd Edition New Age International PrivateLimited*, 2021.

SUGGESTED READINGS:

1. Edward A Bender. *An Introduction to Mathematical Modelling, 1st edition,* DoverPublications Inc, 2003.

2. Rutherford Aris. *Mathematical Modelling Techniques, new edition,* DoverPublications Inc, 2003.

3. Seyed M. Moghadas**.,** Majid Jaberi Douraki**.** *Mathematical Modelling: A GraduateTextbook, first edition,* Jon Wiley and Sons Inc, 2019**.**

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Mathematical Modelling of Geometrical Problems through Ordinary DifferentialEquations of the first order. (section 2.6).

Discipline Specific Elective – DSE

Transforms and Fourier Series

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Transforms and Fourier series**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT4DSE202**					
Course Level	**200**					
Course Summary	The content of the course has wide application in the fields such as application of PDE, Digital Signal Processing, Image Processing, Theory of wave equations, Differential Equations and many others. Theaim of the course is to familiarise the students various tools and techniques related to Laplace transform and Fourier series. Also to equip them to solve applied problems.					
Semester	**4**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites,If any	Calculus, Linear Algebra, Complex Numbers					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand and apply Laplace transform, inverseLaplace transform and to solve ODE	A	1,2,3,4,5
2	Apply various operations on transforms	A	1,2,4,5,6

3	Solve problems using Fourier series	C	1,2,3,6
4	Evaluate Fourier sine and cosine transforms in various Scientific problems	E	1,2,3,4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Laplace Transform, Inverse Transforms,Linearity, Shifting.	1	**15**
	1.2	Transforms of Derivatives and Integrals,Differential equations.	1	
	1.3	Unit Step functions. Second shifting theorem,Dirac's delta function	1	
		Problems (Practicum)	**1**	
	Text 1: Chapter 5 - Sections: 5.1 to 5.3			
2	2.1	differentiation and integration of transforms,	2	**20**
	2.2	Convolution, integral equations	2	
	2.3	partial fractions, Differential Equations	2	
		Problems (Practicum)	**2**	
	Text 1: Chapter 5 - Sections: 5.4 to 5.6			
3	3.1	Fourier series	3	**20**
	3.2	Functions of any period p=2L	3	
	3.3	Even and odd functions and half rangeexpansions	3	
		Problems (Practicum)	**3**	

	Text 1: Chapter 10 - Sections: 10.2 to 10.4			
4	4.1	Fourier sine and cosine transforms,	4	**20**
	4.2	Fourier transform, Tables of transform	4	
		Problems (Practicum)	4	
	Text 1: Chapter 10 - Sections: 10.9 to 10.11			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

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It's purpose is to encourage creativity and develop Problem Solving Skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Lecture, Teaching, Interactive Instruction, Seminar, Group Assignment,Library Work and Group Discussion		
Assessment	**MODE OF ASSESSMENT**		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks
	B	**Semester End Examination (Written)**	
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**	

Types		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Kreyszig, Erwin. *Advanced Engineering Mathematics, Wiley student edition, 8thedition, 2006.*

SUGGESTED READINGS:

1. Lokenath Debnath, Dambaru Bhatta . *Integral Transforms and Their Applications(3rd ed.).* CRC Press Taylor & Francis Group, 2015.
2. Baidyanath Patra. *An Introduction to Integral Transforms*. CRC Press, 2018, IstEdition.
3. Joel L. Schiff. *The Laplace Transform-Theory and Applications*. Springer 1999.
4. Rajendra Bhatia. *Fourier Series (2nd ed.) Texts and Readings in Mathematics*.Hindustan Book Agency, Delhi 2003.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Problem solving from module 1, 2 and 3
- Problems relating to Fourier transform

Discipline Specific Component (DSC B)
Essential Mathematics for Science

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous),
Kothamangalam

FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Chemistry, B Sc Physics, B Sc Statistics etc.</td></tr>
<tr><td>Course Name</td><td colspan="6">Essential Mathematics for Science</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC B)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT4DSC202</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">This Mathematics minor course complements and enhances the undergraduate programmes on science disciplines such as Physics, Chemistry etc., by enabling the students to understand the concepts of complex numbers and analytic functions, to solve differential equations of different types, to identify different conic sections and its applications in possible areas and to determine unit tangent vector, principal normal vector, and curvature of different curves.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Basic awareness of coordinate systems, vectors, functions, derivatives,and integrals</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Apply C-R equations to check the analyticity of complex functions	A	1,2,3,4
2	Solve equations in complex variables anddifferential equations	A	1,2,4,5,6
3	Identify conic sections from its equations and Visualize curves	E	1,2,3
4	Develop applications of mathematical concepts inscientific/real life problems	C	1,2,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Complex Functions**		20
	1.1	Complex Numbers, Sums and Products, Basic Algebraic Properties, moduli, conjugates, Exponential and Polar Forms, Products and Powers in Exponential form	1	
	1.2	Functions of Complex Variables, Separation into Real and Imaginary parts, Limits and Continuity	1	
	1.3	Derivatives, Analytic Function, Cauchy-Riemann Equations, Laplace Equation, HarmonicFunction	2	
		Problems (Practicum)	1, 2	
	Text 1: Chapter 1 – Sections: 1 to 7; Chapter 2 – Sections: 12,15,16,18 to 22, 24 to 26 Theorems – Statements Only			
2		**Differential Equations**		**18**
	2.1	Degree, Order, Solution of Differential Equations, Variable Separable method	2, 4	
	2.2	Exact Differential Equations	2, 4	
	2.3	Linear Differential Equations, Bernoulli's	2, 4	

		Equations		
		Problems (Practicum)	2, 4	
	Text 2: Chapter 1 – Sections: 1.1 to 1.5 Theorems – Statements Only			
3		**Analytic Geometry**		**17**
	3.1	Polar coordinates	3	
	3.2	Conic sections	3	
	3.3	Conic section in polar coordinates	3	
		Problems (Practicum)	3	
	Text 3: Chapter 11 – sections: 11.3,11.6 & 11.7Theorems – Statements Only			
4		**Vector Calculus**		**20**
	4.1	Curves in Space and tangents, Velocity andAcceleration, Arc length in space	4	
	4.2	Curvature and Normal vectors of a curve	4	
	4.3	Directional derivatives and gradient vectors	4	
		Problems (Practicum)	4	
	Text 3: Chapter 13 – Sections: 13.1,13.3,13.4; Chapter 14 – Section: 14.5Theorems – Statements Only			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

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<tr><td colspan="6">Direct Instruction, Brainstorming Lecture, Explicit Teaching, Active Co-operative Learning,</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
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<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

4. James Ward Brown, Ruel V. Churchill. *Complex Variables and Applications*, *EighthEdition*, McGraw Hill, *2009*
5. Simmons, G.F., Krantz, S.G. *Differential Equations*, Tata

McGraw Hill-NewDelhi, 2007.
6. Thomas, George B Jr. *Thomas' Calculus, Twelfth Edition*, Pearson, 2010SUGGESTED

READINGS:

5. Grewal, B. S., *Higher Engineering Mathematics, 44th Edition*, Khanna Publishers,2021.
6. Anton, H., Bivens, Devis. *Calculus, tenth Edition*, Wiley India.
7. Kreyszig,E. *Advanced Engineering Mathematics*, Wiley, India.
8. Siddiqi, A.H., Manchanada, P. *A first course in Differential Equations*, Mc Millan.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Proofs of theorems from module 1, 2, 3 & 4
- Solution of equations in Complex variables, Regions in the Complex plane
- Homogeneous Differential equations, Integrating Factors of Differential Equations
- Visualization of curves and conic section, Obtaining Points of farthest and closestapproach of Planets/ Satellites
- Integration in vector fields, Finding Work done, Flow, circulation and flux
- Text 1-Chapter 1 (Roots of complex numbers, Regions in complex plane)
- Text 2 – Chapter 1 (Homogeneous Differential Equations, Integrating factors)
- Text 3 – Chapter 16 (Line integrals, Work, Circulation and Flux)

Discipline Specific Component (DSC B)

Computational Methods for Business and Economics

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**BA Economics and B Com**
Course Name	**Computational Methods for Business and Economics**
Type of Course	**Discipline Specific Component (DSC B)**

<table>
<tr><td>Course Code</td><td colspan="5">M24MT4DSC203</td></tr>
<tr><td>Course Level</td><td colspan="5">200</td></tr>
<tr><td>Course Summary</td><td colspan="5">Mathematical methods and theories applicable in economics and business to analyse real life problems are included in the course. First module provides an understanding of the way in which financial calculations are worked out. Second module deals with different methods of solving systems of equations and the many varied applications of such systems to business and economics. Optimization of functions using their derivatives is included in the third module. Linear programming is helpful in business and economics where it is often necessary to optimize a profit or cost function subject to several inequality constraints. The graphic approach for maximization and minimization linear programming problems is also illustrated. Module four deals with the applications of calculus in economics and business.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="2">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="5">Graphing functions, Basics of differential and integral Calculus, Multi-variable functions and partial differentiation, Percentage calculation, Basics of logarithmic and exponential functions</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	understand the difference between simple and compound interest	U	1,2,3
2	evaluate a geometric series and calculate the totalinvestment obtained from a regular savings plan.	E	1,2,3,4,5
3	use net present values to appraise investment projects and calculate the internal rate of return, thepresent value of an annuity	A	1,2,3,4
4	understand functions, classical optimizationtechniques and marginal concepts in economics	U	1,2
5	analyse the real-life problems in business and economics and to model it mathematically	A, An, C	1,2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Mathematics of Finance**		**15**
	1.1	Compound Interest	1	
	1.2	Geometric Series	2	
	1.3	Investment Appraisal	2, 3	
		Problems (Practicum)	1,2,3	
	Text 2: Chapter 3 – Sections: 3.2 to 3.4			
2		**Mathematical Economics**		
	2.1	Introduction to System of Equations	3	

	2.2	Graphical Solutions	3	
	2.3	Supply-and-Demand Analysis	3, 4	
	2.4	Break-Even Analysis	3, 4	**20**
	2.5	Elimination and Substitution Methods	3, 5	
	2.6	Income Determination Models	3, 5	
	2.7	IS-LM Analysis	3	
		Problems (Practicum)	3, 4, 5	
	Text 1: Chapter 4 – Sections: 4.1 to 4.7			
3		**Optimization Techniques**		
	3.1	Use of Graphs in LPP, Maximization UsingGraphs	4, 5	
	3.2	The Extreme-Point Theorem, MinimizationUsing Graphs	4, 5	
	3.3	Optimization of Functions, The Successive-Derivative Test	4, 5	**25**
	3.4	Marginal Concepts in Economics	4, 5	
	3.5	Optimizing Economic Functions for Business	4, 5	
	3.6	Relationship Among Total, Marginal, andAverage Functions	4, 5	
		Problems (Practicum)	4, 5	
	Text 1: Chapter 7 – Sections: 7.1 to 7.4; Chapter 10 – Sections: 10.6 to 10.10			

4		**Applications of Mathematics in Economics and Business**		
	4.1	Functions of Several Independent Variables	3, 4	**15**
	4.2	Constrained Optimization problems with Lagrange Multipliers	3, 4	
	4.2	Applications of definite integral in consumers and producers surplus	3, 4, 5	
		Problems (Practicum)	3, 4, 5	
	Text 1: Chapter 12 – Section: 12.11; Chapter 13 – Sections: 13.1 & 13.6			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. as specified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**	
	Direct Instruction, Brain Storming Approach, Interactive instruction, GroupDiscussion, Presentation by Individual Student/ Group Representatives	
	MODE OF ASSESSMENT	
	A	**Continuous Comprehensive Assessment (CCA)**

<table>
<tr><td rowspan="11">Assessment Types</td><td rowspan="3"></td><td colspan="4">Components</td><td>Mark Distribution</td></tr>
<tr><td colspan="4">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="4">Quiz in any mode</td><td>5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Assignment</td><td>5 Marks</td></tr>
<tr><td rowspan="10"></td><td colspan="6">Semester End Examination (Written)</td></tr>
<tr><td colspan="6">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td>Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td></td><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

3. Edward T Dowling, *Mathematical Methods for Business and Economics*, Schaum'sOutline Series, McGraw Hill, 2009.
4. Ian Jacques, *Mathematics for Economics and Business*, 5th Edition, Prentice Hall,2006.

SUGGESTED READINGS:

5. Taro Yamne, *Mathematics for Economists-An elementary survey,* Prentice -Hall, Inc.
6. Robert Brechner, *Contemporary Mathematics for Business and Consumers,* Fifth Edition
7. Das, N. G., Das, J K. *Business Mathematics and Statistics*, Tata McGraw-Hill, 2012.
8. Martin Anthony, Norman Biggs, *Mathematics for economics and finance Methods andModelling*, Cambridge University Press, 2012.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Application mathematics in economics and business using spreadsheets

Foundation Component - VAC

Business Mathematics

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Business Mathematics**					
Type of Course	**Foundation Component - VAC**					
Course Code	**M24MT4VAC200**					
Course Level	**200**					
Course Summary	This course provides a solid foundation in mathematical concepts relevant to business applications. The inclusion of practical lab sessions using Excel enhances the understanding of these concepts through hands-on experience and real-world problem-solving. Students will gain proficiency in applying mathematical tools to analyse economic scenarios, make informed decisions, and solve business-related problems.					
Semester	**4**	**Credits**			**3**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	0	0	**3**
Pre- requisites, If any	Basic Knowledge in Mathematics					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course,the student will be able to		
1	Perform various matrix operations and formulate real life problems into matrix and solve	A	1,2,3,4
2	Sketch graphs of linear equations and solve simultaneous equations using graphical method	A	1,2,3,4,5
3	Formulate and solve system of linear equationsfrom real life problems	C	1,2,3,4,5,6
4	Apply excel spreadsheet functions to perform matrix operations and to solve simultaneous equations and linear programming problems	A, S	1,2,3,4,5,6
5	Learn Freehand Method, Semi-average method, Moving average method & Method of Least squares to analyse underlying causes of trends or systematic patterns over time.	An, A	1,2,3,4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Matrix Algebra**		
	1.1	Introduction to matrices and vectors	1	
	1.2	Basic principles of matrix multiplication, Matrix multiplication – the general case (usingexcel)	1,4	
	1.3	The matrix inverse and the solution	1	
	1.4	Determinants (using excel)	1, 4	
	1.5	Minors, cofactors and the Laplace expansion	1	

				18
	1.6	The transpose matrix, the cofactor matrix, the adjoint and the matrix inverse formula (Exclude the derivation of the matrix-inverse formula)	1	
	1.7	Application of the matrix inverse to the solution of linear simultaneous equations(using excel)	1, 4	
	1.8	Cramer's rule	1	
	1.9	Input- Output Analysis	1	
	Text 1: Chapter 15 - Sections 15.1 to 15.9 & 15.12			

2		**Linear Programming Problems**		**15**
	2.1	Linear Equations: Straight line graphs, An Economic Application- Supply and Demand	2	
	2.2	Simultaneous Equations	2	
	2.3	Linear Inequalities: Inequalities & EconomicApplications	2	
	2.4	Linear Programming - Formulation andGraphic Solution (using excel)	3, 4	
	Text 2: Chapter 1 – Sections: 1.1, 1.2, 1.3(Excluding Complications, Three Equations in Three Unknowns and Gaussian Elimination); Chapter 2 – Sections: 2.1 & 2.2 **Text3: Chapter 2 (excluding section 2.5)**			
3		**Interpolation and Time Series Analysis**		**12**
	3.1	Time Series, Necessity of time series analysis	5	
	3.2	Components of time series, Some adjustmentsof time series data	5	
	3.3	Measurement of trend: Freehand Method, Semi-average method, Moving average method, Method of Least squares. (Linear Trend only)	5	
	Text 4: Chapter 18 - Sections 18.1 to 18.8			

4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**
	Verbal Exposition Case Studies: Applying matrix algebra to business scenarios. In-Class Demonstrations: Visualizing matrix operations in action. Think-Pair-Share Activities: Encouraging peer collaboration in understandingconcepts. Flipped Classroom Approach: Pre-learning materials before class discussions.
	Scenario-based Learning: Learning through hypothetical business scenarios. Online Quizzes and Exercises: Reinforcing learning through practice. Concept Mapping Exercises: Creating visual representations of interrelatedconcepts.

<table>
<tr><td rowspan="8">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td rowspan="3">A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td colspan="4">Components</td><td>Mark Distribution</td></tr>
<tr><td colspan="4">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="4">Assignment</td><td>5 Marks</td></tr>
<tr><td rowspan="4">B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td colspan="5">Question Pattern
[[Maximum Time 90 Minutes, Maximum Marks 50]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>1 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>4</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td>II</td><td>4</td><td>2</td><td>2</td><td>8</td></tr>
</table>

		III	4	2	1	**7**
		Total no of questions	**12**	**6**	**4**	**22**
		Number of questions to be answered	**10**	**4**	**2**	**16**
		Total Marks	**10**	**20**	**20**	**50**

TEXT BOOKS:

1. Rosser, Mike, and Piotr Lis. *Basic mathematics for economists*. 3rd ed. Routledge,2016.
2. Pemberton, Malcolm, and Nicholas Rau. *Mathematics for economists: anintroductory textbook,4th ed*. Manchester University Press, 2016.
3. ND, Vohra. "Quantitative techniques in management.", 3rd ed. Tata McGraw HillNew Delhi, 2007.
4. Ghosh, Ram Krishna, and Suranjan Saha. *Business Mathematics and Statistics,(Algebra, Geometry, and Business Statistics)*. New Central Book Agency, 2019.
5. Harmon, Mark. "Step-by-step optimization with Excel Solver." *Excel Master Series*, 2011.

SUGGESTED READINGS:

1. Mavron, Vassilis C., and Timothy N. Phillips. *Elements of Mathematics for Economics and Finance*. Classroom Companion: Economics. Springer Cham, 2023.
2. Newbold, Paul, et al. *Statistics for Business and Economics*. Pearson EducationLimited, 2023

ADVANCED READINGS:

1. Manna, Asim Kumar. *Business Mathematics and Statistics*, McGraw Hill Education(India) Private Limited, 2018.
2. Bradley, Teresa. *Essential Mathematics for Economics and Business*, 4th edition, JohnWiley & Sons, 2013.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS

- Lab sessions using excel spreadsheet to perform matrix multiplication and to evaluatedeterminants.
- Lab sessions using excel spreadsheet to find the inverse of a matrix and to solvesimultaneous equations

- Lab sessions using excel spreadsheet to solve linear programming problems (ReferText 5)
- Practical sessions can be included

Foundation Component - SEC

Document preparation using LaTeX

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Document preparation using LaTeX**					
Type of Course	**Foundation Component - SEC**					
Course Code	**M24MT4SEC20**					
Course Level	**200**					
Course Summary	This course introduces students to the LaTeX typesetting system, a powerful tool for document preparation widely used in academia and industry. Building on basic LaTeX concepts, students will learn advanced techniques for creating professional-quality documents, including complex formatting, mathematical typesetting, and bibliography management.					
Semester	**4**	**Credits**			**3**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/Week
		3	0	0	0	**3**
Pre-requisites,If any	Computer Knowledge					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Explain the fundamental principles of LaTeX typesetting	U,S	1,2,3
2	Apply advanced LaTeX formatting techniques tocreate professional-quality documents	A,S	1,2,3,4,5
3	Analyse and troubleshoot common errors in LaTeX documents	A,S	1,2,3,4,5,6
4	Create and customize bibliographies usingBibTeX in LaTeX	C,S	1,2,3
5	Demonstrate effective collaboration using LaTeXfor group writing projects	A,S	1,3,4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Preparing the input file	1	**18**
	1.2	Sentences and paragraphs, the document,sectioning, displayed material	1	
	1.3	Running LaTeX	1,3	
	1.3	Changing the type style	2	
	1.4	Mathematical Formulas: common structures, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Putting one thing above another, spacing and changing style in math mode.	2	
	Text 1: Chapter 2 – Sections: 2.1 to 2.3; Chapter 3 – Sections: 3.1 & 3.3			
	2.1	Defining commands and environments	3	

2	2.2	Figures and other floating bodies: Figures andTables	2	**12**
	Text 1: Chapter 3 – Sections: 3.4 & 3.5.1			

3	3.1	Cross references	3	**15**
	3.2	Bibliography and citation	4	
	3.3	Books	2	
	3.4	Slides: Slides and overlays	5	
	Text 1: Chapter 4 – Sections: 4.2 & 4.3; Chapter 5 – Sections: 5.1 & 5.2.1			
4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	1. Interactive Instructions using ICT tools 2. Hands on Training		
Assessment Types	**MODE OF ASSESSMENT**		
	A	**Continuous Comprehensive Assessment (CCA)** Practical sessions or exams may be organised for each module andthe CCA should be based on these hands on experiences. One of the following Activity should be done during the course. Textbook Content Preparation: As part of CCA student must submit a document of at least 3 pages using a mathematics reference texts of students or faculties choice. This document must be considered for CCA.	
		Components	**Mark**

					Distribution	
		Teacher Specific Content			20 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 90 Minutes, Maximum Marks 50]**				
		Module	Part A	Part B	Part C	Total
			1 Marks	**5 Marks**	**10 Marks**	
		I	4	2	1	**7**
		II	4	2	2	**8**
		III	4	2	1	**7**
		Total no of questions	**12**	**6**	**4**	**22**
		Number of questions to be answered	**10**	**4**	**2**	**16**
		Total Marks	**10**	**20**	**20**	**50**

TEXT BOOK:

1. Lamport, Leslie. *LaTeX: A Document Preparation System*, Addison-Wesley,2nd edition, 1994.

SUGGESTED READINGS:

1. Goossens, M., Mittelbach, F. F., Samarin, a. *The LaTeX Companion*, Addison-Wesley, 1993.
2. Krishnan, E. *LATEX Tutorials: A Primer*, Indian TEX Users Group, 2004

Semester 5

CourseCode	Title of the Course	Type of the Course	Credit	Hours/ Week
M24MT5DSC300	A First Course in Complex Analysis	Discipline Specific Component - DSC A	4	5
M24MT5DSC301	Limits and Convergence	Discipline Specific Component - DSC A	4	4
M24MT5DSE302	Fundamentals of Groups and Rings	Discipline Specific Component - DSC A	4	4
M24MT5DSC303	Differential Equations and Applications	Discipline Specific Component - DSC A	4	4
M24MT5DSE300	Data Analysis Using Python (S)	Discipline Specific Elective - DSE	4	5
M24MT5DSE301	Mathematical Musings Beyond Classroom	Discipline Specific Elective - DSE	4	5
M24MT5DSE302	An Invitation to Fuzzy Mathematics	Discipline Specific Elective - DSE	4	5
M24MT5DSE303	Exploring the Harmony of Automata	Discipline Specific Elective - DSE	4	5
M24MT5SEC300	Operation Research	Foundation Component - SEC	3	3

Discipline Specific Component (DSC A)

A First Course in Complex Analysis

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">A First Course in Complex Analysis</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT5DSC300</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">The objective of this course is the introduction of basic concepts of complex analysis through a problem oriented approach. The course is designed for an understanding of elementary contour integrals, which serves as a powerful means to compute definite integrals and analyze the behaviour of complex functions. The Cauchy-Goursat theorem and Cauchy's integral formula which leads to the construction of Taylor series and Laurent series, the power series expansions that capture the intricate behaviour of analytic functions around specific points are analyzed through the course. The concepts of singularities, poles and resides along with their evaluation are introduced. Improper integrals, definite integrals with one or both limits of integration infinite, are being evaluated using the Cauchy’s Residue Theorem.</td></tr>
<tr><td>Semester</td><td>5</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Complex numbers and operations, Regions of complex plane, Basic properties of functions of complex variables, Elementary functions of complex variables.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand elementary contour integrals, complex plane's domains, singular points, and their classifications including isolated, removable and essential singularities.	U	1,4,5,6
2	Apply Cauchy - Goursat theorem, Cauchy's integral formula, and Cauchy's residue theorem to calculate contour integrals, showcasing expertise in complex integration techniques.	A, An	1,2,3
3	Effectively categorize poles and zeros of analytic functions, demonstrating a clear understanding of their roles in function behaviour and singularities.	An	1,2,3,4,5
4	Construct series expansions for analytic functions using appropriate techniques, demonstrating proficiency in representing complex functions using power series.	C	1,2,4,5,6
5	Evaluate improper integrals using the residue theorem, showcasing the versatility of complex integration methods in solving problems involving improper integrals.	E	1,2,3,4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Integration of Complex Functions**		**22**
	1.1	Definite integrals of functions	1	
	1.2	Contours and contour integrals, Some examples, Upper bounds for moduli ofcontour integrals	1	
	1.3	Anti derivatives, Cauchy-Goursat Theorem (statement only), Some consequences of theextension	2	
	1.4	Simply and multiply connected domains	1	
	1.5	Cauchy's integral formula, An extension of Cauchy's integral formula	2	
	1.6	Liouville's theorem and Fundamental theorem of algebra, Maximum modulus principle.	2	
		Problems (Practicum)	1, 2	
	Text 1: Sections: 38 to 41, 43, 44, 46, 48 to 54			
2		**Series of Complex Functions**		15
	2.1	Convergence of sequences and series	1	
	2.2	Taylor series, Proof of Taylor's Theorem,Examples	4	
	2.3	Laurent Series, Examples	4	
		Problems (Practicum)	1, 4	
	Text 1: Sections: 55 to 60 & 62			
3		**Residues and Poles**		**18**
	3.1	Isolated singular points, residues, Cauchy'sResidue Theorem	1	
	3.2	Three types of isolated singular points,Residues at poles, examples.	1	

	3.3	Zeros of analytic functions, Zeros and poles	3	
		Problems (Practicum)	1, 3	
	Text 1: Sections: 68 to 70, 72 to 76			
4		**Evaluation of Improper Integrals**		**20**
	4.1	Evaluation of improper integrals, Example	5	
	4.2	Improper integrals from Fourier analysis. Jordan's Lemma (statement only)	5	
	4.3	Definite integrals involving sines and cosines	5	
		Problems (Practicum)	5	
	Text 1: Sections: 78 to 81 & 85			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.

It's purpose is to encourage creativity and develop Problem solving skills.

The practicum component is to be done in the classroom under the strict guidance of the teachers.

A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

	Classroom Procedure (Mode of transaction)

Teaching andLearning Approach	Lecture methods Problem solving Methodologies Activity based Tutorials/ Practical Software based visualisation of concepts		
Assessment Types	**MODE OF ASSESSMENT**		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks

	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**				
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Brown, James Ward, Ruel V. Churchill. C*omplex variables and Applications* (8thedition). McGraw-Hill, 2009.

SUGGESTED READINGS:

1. Saff, E. B., Snider A. D., *Fundamentals of Complex Analysis with Applications toEngineering, Science and Mathematics*. Pearson, 2002.
2. Ponnusamy, S., Herb Silverman. *Complex variables with applications.* SpringerScience & Business Media, 2007.
3. Krantz, Steven G. *Complex Variables: A physical approach with applications andMATLAB.* CRC Press, 2007.
4. Kasana, Harvir Singh. *Complex variables: theory and applications*. PHI LearningPvt. Ltd., 2005.
5. Zill, Dennis G., Patrick D. Shanahan. *Complex analysis: A first course withapplications*. Jones & Bartlett Publishers, 2013.
6. Choudhary, B. *The elements of complex analysis*. New Age International, 1993.
7. Jeffrey, Alan. *Complex analysis and applications*. CRC Press, 2005.

ADVANCED READINGS:

1. Mathews, John, and Russell Howell. *Complex Analysis for Mathematics andEngineering*. Jones & Bartlett Publishers, 2012.
2. Cartan, Henri. *Elementary Theory of Analytic functions of one or several Complexvariables.* Courier Corporation, 1995.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Proof of Cauchy - Goursat Theorem
- Proof of Extension of Cauchy's Integral Formula
- Proof of Laurent's Theorem
- Finding complex integrals, zeros, poles and residues using online software likeWolfram Alpha
- Proof of Jordan's Lemma
- Presenting reports on the applications of complex integrals in other subjects / areas

Discipline Specific Component (DSC A)

Limits and Convergence

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Limits And Convergence</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT5DSC301</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course offers a robust foundation in the analysis of sequences, series and the concept of limits of functions and thereby develops a comprehensive understanding of the mathematical structures crucial to calculus. Topics include limits of sequences, monotone sequences, subsequences, proper divergence, Cauchy sequences, and infinite serieswith a focus on convergence criteria, comparison tests, and special attention to tests like Root and Ratio, Raabe’s, Alternating Series, Dirichlet and Abel test. The course also discusses the limit concepts of real functions. By course end, students possess a solid foundation for mathematical analysis.</td></tr>
<tr><td>Semester</td><td>5</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Fundamental of real analysis.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Analyse various convergence methods f	An	1,2,3
2	Examine the concept of sub sequences and demonstrate proficiency in analysing their properties within mathematical contexts.	An, A	1,2,3
3	Analysis and application of Cauchy sequences in mathematical contexts, demonstrating proficiency in understanding their convergence properties.	An, A	1,2,3
4	Comprehend fundamental concepts of infinite series and apply various tests for establishing their convergence or divergence.	U, A	1,2,3
5	Apply alternative series tests specifically tailored for non-absolute convergence scenarios, demonstrating a nuanced understanding within mathematical contexts.	A	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Sequences and Their Limits	1	15
	1.2	Limit Theorems	1	
	1.3	Monotone Sequences	1	
	Text 1: Chapter 3 - Sections: 3.1, 3.2 (Theorems 3.2.3 and 3.2.11 – statements only), 3.3 (up to 3.3.3)			
	2.1	Subsequences and the Bolzano-WeierstrassTheorem.	2	

2	2.2	The Cauchy Criterion	3	**15**
	2.3	Properly Divergent Sequences	4	
	Text 1: Chapter 3 - Sections: 3.4 (Theorems 3.4.11 and 3.4.12 – statements only), 3.5 (up to 3.5.8, Theorem 3.5.8 – statement only) & 3.6.			
3	3.1	Infinite Series- n^{th} term test, comparisontest, limit comparison test.	4	**15**
	3.2	Absolute Convergence, Grouping andrearrangements of series	4	
	3.3	Tests for Absolute Convergence: Limit comparison Test II, The Root and Ratio Test (Concepts and Problems only)	4	
	3.4	The Raabe's Test (Concepts and Problemsonly)	4	
	3.5	Test for Nonabsolute Convergence: Alternating Series Test, The Dirichlet andAbel test. (Concepts and Problems only)	5	
	Text 1: Chapter 3 - Sections: 3.7; Chapter 9 - Sections: 9.1 (Theorem 9.1.5 – statement only), 9.2.1 to 9.2.5, 9.2.8 to 9.2.10 & 9.3 (Concepts, statementsof the theorems and problems only from sections 9.2 and 9.3)			
4	4.1	Limits of Functions	5	**15**
	4.2	Limit Theorems	5	
	4.3	Some Extensions of the Limit Concept	5	
	Text 1: Chapter 4 - Sections: 4.1 (Theorems 4.1.6 and 4.1.9 – statements only), 4.2 (Theorems 4.2.4 and 4.2.9 – statements only), 4.3 (Concepts,statements of the theorems and problems only)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Robert G Bartle., Donald R Sherbert. *Introduction to Real Analysis(4th Edition)*,Wiley Internationals, 2000

SUGGESTED READINGS:

1. Denlinger, Charles. *Elements of real analysis*. Jones & Bartlett Learning, 2011.
2. Howie, John M. *Real analysis*. Springer Science & Business Media, 2006.
3. Abbott, Stephen. *Understanding analysis*. springer publication, 2015.
4. Ghorpade, Sudhir R., Balmohan Vishnu Limaye. *A course in calculus and realanalysis*. New York: Springer, 2006.
5. Kumar, Ajit, Kumaresan, S. *A basic course in real analysis*. CRC press, 2014.

ADVANCED READINGS:

1. Gelbaum, Bernard R., and John MH Olmsted. *Counterexamples in analysis*. CourierCorporation, 2003.
2. Rudin, Walter. *Principles of mathematical analysis*. Vol. 3. New York: McGraw-hill,1976.
3. Apostol, Tom M. *Mathematical analysis*. 1974.
4. Royden, Halsey Lawrence, and Patrick Fitzpatrick. *Real analysis*. Vol. 2. New York:Macmillan, 1968.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- The
- The K(€) Game.
- Corollary 3.5.10 and approximate solutions of equations.
- Calculation of Square roots.
- Euler Number.
- Fibonacci fractions and golden ratio.
- The integral test.
- Proof of theorems 3.2.3 and 3.2.11.
- Proof of theorems 3.4.11, 3.4.12 and 3.5.8.
- Proof of theorem 9.1.5, proof of all theorems of Section 9.2 and Section 9.3.
- Proof of theorems 4.1.6, 4.1.9, 4.2.4 and 4.2.9.
- Proof of all theorems of Section 4.3.

Discipline Specific Component (DSC A)
Fundamentals of Groups and Rings

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Fundamentals of Groups and Rings</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT5DSE302</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">The objective of the course is to introduce group and ring theory for a beginner.
The basic algebraic structure group, its subgroups, cyclic groups, permutations, cosets, homomorphisms, and normal subgroups arecovered in the first three modules.
Rings and Fields are introduced in the fourth module.</td></tr>
<tr><td>Semester</td><td>5</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Basic Set Theory and Mathematical Operations</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Comprehend binary operations, isomorphicstructures, groups, and subgroups.	U	1,2,3
2	Analyse cyclic groups and permutation groups and apply these concepts to solve problems in group theory.	A	1,2
3	Use cosets to prove Lagrange's theorem, analyse homomorphisms, and understand Cayley's Theorem.	A	1,3,5,
4	Analyse rings, fields, and integral domains, andthus become adept in algebraic structures.	A	1,2,6
5	Apply the ideas of Groups and Permutation in Practical Situations.	A	1,3,4,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours:
1	1.1	Binary Operations – Definitions and Examples	1	**15**
	1.2	Groups – Definition, Examples	1	
	1.3	Groups - Elementary Properties	1	
	1.4	Group Isomorphism, Group Tables and Examplesof Abelian Groups	1	
	Text 1: Chapter 1 – Sections: 1.1 to 1.30; Chapter 2 – Sections: 2.1 to 2.23; Chapter 3 – Sections: 3.1 to 3.5			
	2.1	Examples of non-abelian groups and PermutationGroup	2	

2	2.2	Symmetric Groups and Disjoint Cycles	2	**15**
	2.3	Subgroups, Cyclic Groups and Cyclic Subgroups	2	
	Text 1: Chapter 4 – Sections: 4.1 to 4.16; Chapter 5 – Sections: 5.1 to 5.26; Chapter 6 – Sections: 6.1 to 6.21			
3	3.1	Generating Sets	**3**	**15**
	3.2	Group Homomorphism and Group of Permutation	3, 5	
	3.3	Kernel, Cayley's Theorem, Even and Odd Permutation	3, 5	
	3.4	Cosets and Theorem of Lagrange	3	
	Text 1: Chapter 7 – Sections: 7.1 to 7.6; Chapter 8 – Sections: 8.1 to 8.25; Chapter 10 – Sections: 10.1 to 10.20			
4	4.1	Rings and Fields	4	**15**
	4.2	Integral Domain, Characteristic of a Ring.	4	
	4.3	Field of Quotients of an Integral Domain(Statement only)	4	
	Text 1: Chapter 22 – Sections: 22.1 to 22.18; Chapter 23 – Sections: 23.1 to 23.14; Chapter 26 Examples: 26.1 & 26.6 (Theorem 26.6-Statement only)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Lectures, Tutorials, Interactive Sessions, Blended Learning		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark**

<table>
<tr><td rowspan="11">Assessment Types</td><td rowspan="4"></td><td colspan="4"></td><td>Distribution</td></tr>
<tr><td colspan="4">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="4">Quiz in any mode</td><td>5 Marks</td></tr>
<tr><td colspan="4">Assignment</td><td>5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="7"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Fraleigh, John B.;. Brand, Neal E, *A First Course in Abstract Algebra* 8th ed, PearsonEducation 2021
2. Gallian, Joseph A. *Contemporary Abstract Algebra,* 10th edition, Cengage, 2021.

SUGGESTED READINGS:

1. Dummit, David S., and Richard M. Foote. *Abstract Algebra. 3rd ed.* Wiley, 2003.
2. Artin, M. *Algebra. 2nd ed., Pearson Education 2017*
3. Herstein, I. N. *Topics in Algebra,* 2nd *Edition, John Wiley and sons, 2010*
4. Musili, C. *Rings and Modules 2nd* revised *Edition, Narosa 1997*

ADVANCED READINGS:

1. Hungerford, Thomas.W., Algebra, 4th Print 2003 Edition.
2. Lang, Serge, Algebra, 4th Print 2005 Edition

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Realisation of the group D_4 as symmetries of a square. (Chapter 1 of Text 2)
- Rotations of a Regular Tetrahedron and Application in Chemistry (Chapter 5 –Example 10 of Text 2)
- Group Theory Puzzle – Rubik's Cube (Chapter 5 of Text 2)

Discipline Specific Component (DSC A)
Differential Equations and Applications

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Differential Equations and Applications</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT5DSC303</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">The course covers basics of ordinary and partial differential equations, various methods for solving them and also include some practical applications.</td></tr>
<tr><td>Semester</td><td>5</td><td colspan="2">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Basic knowledge of functions, differentiation and integration.
Basic understanding of ordinary and partial differential equations, including degree and order.
Knowledge in constructing ordinary differential equations.
Basic understanding of the concept of solutions.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:

	Upon the successful completion of the course, thestudent will be able to		
1	Develop the idea of solving first orderDifferential Equations	A	1,2,3
2	Apply first order Differential Equations to practical situations and solve	A, An	1,4,5,6
3	Solve higher order Differential Equations	A	1,2,3
4	Develop the concept of Partial Differential Equations and solve	U, A	1,2,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Exact Differential Equations and IntegratingFactors	1	15
	1.2	Separable Equations and EquationsReducible to this form	1	
	1.3	Linear Equations	1	
	1.4	Bernoulli Equations	1	
	Text 1: Chapter 2 – Sections: 2.1 (Theorem 2.1 statement only), 2.2 & 2.3			
2	2.1	Finding Integrating Factors	1	10
	2.2	A Special Transformation	1	
	2.3	Orthogonal Trajectories	2	
	2.4	Geometric Applications	2	
	Text 1: Chapter 2 – Sections: 2.4 A & 2.4 B; Chapter 3 – section: 3.1 A, Text 2: Chapter 12 - section 12.2			
	3.1	Definition and Basic Existence Theorem	3	

3	3.2	The Homogeneous Equation	3	**25**
	3.3	Reduction of Order	3	
	3.4	The Non-Homogeneous Equation	3	
	3.5	The Homogeneous Linear Equation withConstant Coefficients	3	
	3.6	The Method of Undetermined Coefficients	3	
	3.7	Variation of Parameters	3	
	Text 1: Chapter 4 – Sections: 4.1 A, 4.1 B, 4.1 C, 4.1 D, 4.2, 4.3, 4.4			
4	4.1	Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$	4	**10**
	4.2	Partial Differential Equations, Origin of First Order Partial Differential Equations	4	
	4.3	Linear Equations of First Order PartialDifferential Equations	4	
	Text 3: Chapter 1 – Section: 3; Chapter 2 - sections-1,2,4 (Theorem 2 & 3 statement only)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Direct Instruction: Explicit Teaching, Lecture. Interactive Instruction: Active Co-operative Learning, Group Assignments		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks
		Seminar	5 Marks
		Assignment	5 Marks
	B	**Semester End Examination (Written)**	
		Question Pattern [Time 2 Hours, Maximum Marks 70]	

Assessment Types	Module	Part A	Part B	Part C	Total
		2 Marks	**5 Marks**	**10 Marks**	
	I	3	2	1	**6**
	II	3	3	1	**7**
	III	3	2	1	**6**
	IV	3	2	1	**6**
	Total No of Questions	**12**	**9**	**4**	**25**
	Number of Questions to be Answered	**10**	**6**	**2**	**18**
	Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Ross, Shepley L. *Differential Equations*. 3rd ed. Wiley. 2013.
2. Grewal, B. S.. *Higher Engineering Mathematics.* 42nd ed. KhannaPublications. 2012
3. Sneddon, Ian N.. *Elements of Partial Differential Equations*. 1st ed.McGraw-Hill. 1957

SUGGESTED READINGS:

1. Simmons, George F., Steven G Krantz.. *Differential Equations -Theory,Technique, and Practice*. 1st ed. McGraw-Hill (Walter Rudin Student Series). 2007
2. Amaranath,T.. *An Elementary Course in Partial DifferentialEquations,* 2nd ed. Jones and Bartlett. 2 0 0 9

ADVANCED **READING:**

1. Simmons, George F.. *Differential Equations with Applicationsand Historical Notes.* 3rd ed. CRC Press, Taylor & Francis. 2016

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Applications of Ordinary Differential Equations of First Order inSimpleElectric Circuits
- Rate of Decay of Radioactive Materials

- Chemical Reactions and Solutions
  (Text 2: Chapter 12-Section 12.5, 12.8, 12.9)

Discipline Specific Elective – DSE

Discipline Specific Component (DSC A)

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Data Analysis using Python**					
Type of Course	**Discipline Specific Component (DSC A)**					
Course Code	**M24MT5DSE300**					
Course Level	**300**					
Course Summary	This course is intended to perform statistical analysis on data to understand its behavior. It provides a strong foundation on how to identify various distributions. This course also provide information regarding how to identify various statistical tests and to implement different parametric and non-parametric tests. Identification and implementation of different types of ANOVA and correlation analysis in Python is also provided in this course.					
Semester	**5**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre- requisites,If any	Basic Knowledge in Python					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, the student will be able to		

1	Understand various probability distributions	U	1,5,6
2	Understand, apply and analyze various parametric tests	U, A, An	1,2,3,4
3	Understand, apply and analyze various non-parametric tests	U, A, An	1,2,3,5
4	Understand, apply and analyze ANOVA and Correlation	U, A, An	1,2,5,6
5	Apply, Analyze and Evaluate various statistical tests based on case studies	A, An, E	1,2,3,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Introduction to probability distributions	1	**15**
	1.2	How to identify a distribution - Binomial, Poisson, Normal, Exponential, Chi-Squared, Student's t, F and Uniform distribution.	1	
	1.3	Parametric tests Vs. Non-parametric tests	1	
		Problems (Practicum)	1	
	Text 1: Chapter 7			
2	2.1	Introduction – Different types of parametric tests	2,5	**20**
	2.2	Z-test – One sample Z-test, Two-sample Z-test	2,5	
	2.3	Student's t-test- One Sample Student's t-test, Independent Two-Sample Student's t-test, Paired Student's t-test	2,5	
	2.4	F-test	2,5	
		Problems (Practicum)	2,5	
	Text 1: Chapter 8			

3	3.1	Introduction – Different types of non-parametric tests	3,5	**20**
	3.2	Fisher's Exact test	3,5	
	3.3	Pearson's Chi-square test, Goodness of Fit	3,5	
	3.4	One sample Wilcoxon- Signed Rank test, Two sample Wilcoxon signed rank test – paired, Two sample Wilcoxon ranksum test - unpaired (Mann-Whitney test),	3,5	
	3.5	Kolmogrov Smirnov test	3,5	
	3.6	K-samples test - Kruskal-Wallis H test.	3,5	
		Problems (Practicum)		
	Text 1: Chapter 9			
4	4.1	Introduction to ANOVA, Types of ANOVA	4,5	**20**
	4.2	One-way ANOVA, Two-way ANOVA, Repeated measures ANOVA.	4,5	
	4.3	Introduction to correlation, Types of correlation	4,5	
	4.4	Parametric correlation – Pearson correlation	4,5	
	4.5	Non-parametric correlation – Kendall correlation, Spearman correlation.	4,5	
		Problems (Practicum)		
	Text 1: Chapter 10			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. as specified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
It's purpose is to encourage creativity and develop Problem Solving Skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture, Seminar, Group Assignment, Interactive Assignment, Lab Work</td></tr>
<tr><td rowspan="12">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="7"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
</table>

		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Jeeva Jose, Data Analysis and Visualization using Python, Khanna Publishers, New Delhi, 2024.

SUGGESTED READINGS:

10. John Shovic, Alan Simpson, Python All-in-One for Dummies, Wiley, 2020
11. Thomas Haslwanter, An Introduction to Statistics with Python, 2015

WEB RESOURCES:

- https://dataalltheway.com/posts/010-02-parametric-hypothesis-tests-python/index.html
- https://machinelearningmastery.com/parametric-statistical-significance-tests-in-python/
- https://machinelearningmastery.com/nonparametric-statistical-significance-tests-in-python/
- https://www.analyticsvidhya.com/blog/2024/04/one-way-and-two-way-analysis-of-variance-anova/

Discipline Specific Elective – DSE

Mathematical Musings beyond Classroom

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Mathematical Musings beyond Classroom**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT5DSE301**					
Course Level	**300**					
Course Summary	Step beyond the confines of classrooms, where mathematics transforms from a mere subject into a gateway, leading you to infinite possibilities and allowing you to revel in the beauty of mathematics.					
Semester	**5**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre- requisites, If any	Nil					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Acquire a solid understanding of fundamental mathematical concepts including algebra, geometry,calculus, and probability.	K	1,2,3

2	Understand the evolution of mathematical thought and its role in shaping scientific and technologicaladvancements.	U	1,2,3,4
3	Develop the ability to apply mathematical principles to solve real-world problems.	A	1,2
4	Discuss ethical considerations in mathematical research and applications. Encourage students to critically reflect on their own learning and understanding of mathematical concepts.	E	4,6,8,9
5	Demonstrate how mathematics intersects with various disciplines, including science, arts, and humanities.	C	3,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom Transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Exploring Enchanting Texts**		**20**
	1.1	An Introduction to Exploring Enchanting Texts of Mathematics.	1	
	1.2	Text Book 1 Chapter- 1: Nothing Doing [The Origin of Zero], Chapter- 3: Nothing Ventured [Zero Goes East]	2,5	
	1.3	Text Book 2 Part Five: Data (Chapter- 22: The New Normal, Chapter- 23: Chances Are, Chapter- 24: Untangling the Web)	1, 2,3,5	
	1.4	Text Book 3 Chapter- 3: Einstein vs. Dostoyevsky	2, 4	
		Practicum (Problem)	1,2,3,4, 5	
	Text 1, Text 2, and Text 3			

2		**Math Meets the Silver Screen**		**15**
	2.1	Introduction to Mathematics on the SilverScreen.	1	
	2.2	The film *A Beautiful Mind* (2001) directed byRon Howard.	3,4	
	2.3	The film *The Imitation Game* (2014) directedby Morten Tyldum.	2,3	
	2.4	The film *The Man Who Knew Infinity* (2015)directed by Matthew Brown.	2,3,4	
	2.5	The film *Hidden Figures* (2016) directed by Theodore Melfi.	2,4,5	
		Practicum (Problem)	1, 2,3,4,5	
3		**Mathematical Prelude: Kerala's Historical Journey**		**20**
	3.1	The Actors, The Social Background.	1,2	
	3.2	The Motivation and Method, The Madhava-Gregory Series for the Inverse Tangent, The Madhava- Newton Power Series for the Sine and Cosine.	2	
	3.3	Transmission of Kerala Mathematics: Establishing Transmissions: A Digression,The Case for Transmission: Applying the Neugebauer Criteria.	2	
	3.4	The Case for Transmission: Applying the Legal Standard of Motivation and Opportunity, A Conjecture on the Mode of Acquisition of Manuscripts by the Jesuits.	2,4	
	Text 4: Chapter- 10: A Passage to Infinity: The Kerala Episode.			
4		**Unveiling the Philosophy of Mathematics**		**20**
	4.1	Text Book 5 Part One, Chapter- 5: Five Classical Puzzles.	2	
	4.2	Text Book 6 Chapter- 1: Mathematics and Its Philosophy(Sections 1.1 &1.2).	2,4	
	4.3	Text Book 6 Chapter- 2: The Limits of Mathematics.	2,4	

	Text 5 and Text 6
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visitetc. as specified by the teacher concerned)* **This content will be evaluated internally**

Practicum

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It's purpose is to encourage creativity and develop Problem Solving Skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**					
	Direct Instruction, Brain Storming Approach, Interactive Instruction,Watching Movies, Group Discussion, and Presentation by IndividualStudent/ Group Representatives.					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			**Mark Distribution**	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern [Maximum Time 2 Hours, Maximum Marks 70]				
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**

		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Seife, Charles. *Zero*: *The Biography of a Dangerous Idea*. United States, Penguin Publishing Group, 2000.
2. Strogatz, Steven Henry. *The Joy of X: A Guided Tour of Math, from One to Infinity*.United States, Houghton Mifflin Harcourt, 2012.
3. Hoffman, Paul. *The Man Who Loved Only Numbers*: *The Story of Paul Erdos and theSearch for Mathematical Truth*. London, Fourth Estate, 1999.
4. George Gheverghese Joseph. *The Crest of the Peacock - Non-European Roots of Mathematics* (3rd Edition). Princeton University Press, Princeton & Oxford, 2011.
5. Hersh, Reuben. *What is Mathematics, Really?*. United Kingdom, Oxford University Press, 1997.
6. Colyvan, Mark. *An Introduction to the Philosophy of Mathematics*. United Kingdom,Cambridge University Press, 2012.

SUGGESTED READINGS:

1. Singh, Simon. *Fermat's Last Theorem*. United Kingdom, Harper Collins Publishers,2012.
2. Oakley, Barbara A. *A Mind for Numbers: How to Excel at Math and Science (Even IfYou Flunked Algebra)*. United Kingdom, Penguin Publishing Group, 2014.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Reading of the related books:
- Nasar, Sylvia. *A Beautiful Mind*. United Kingdom, Faber &Faber, 2012.
- Hodges, Andrew, and Hofstadter, Douglas. *Alan Turing: The Enigma: The Book That Inspired the Film The Imitation Game* -Updated Edition. United Kingdom, Princeton University Press, 2014.
- Kanigel, Robert. *The Man Who Knew Infinity: A Life of the Genius Ramanujan*. India, Washington Square Press, 2016.
- Shetterly, Margot Lee. *Hidden Figures*. United States, Harper Collins, 2018.
- Visit a place of mathematical importance.
- Book Reviews/Film Reviews/Group Discussions/Debates.

Discipline Specific Elective – DSE

An Invitation to Fuzzy Mathematics

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**An Invitation to Fuzzy Mathematics**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT5DSE302**					
Course Level	**300**					
Course Summary	This course provides a warm introduction to Fuzzy Mathematics, highlighting its significance and showcasing the academic accomplishments of our undergraduate participants. It also offers an overview of the course by having students present the foundational principles and key theories covered, emphasizing their understanding and application.					
Semester	**5**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites,If any	Text 3					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Comprehensive understanding of fuzzy set theory	U	1,2,3,4
2	To acquire proficiency in performing operations onfuzzy sets and fuzzy relations.	A	1,2
3	To develop the skills to use fuzzy tools and techniques in various fields such as graphs.	S	1,4,5,6

4	To handle the real-life situations using Fuzzy Graphs	I	1,2,4,5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Crisp Sets: An over view	1	**20**
	1.2	Fuzzy Sets: Basic Types & Concepts	1	
	1.3	c) Alpha Cuts	1	
	1.4	d) Additional properties of Alpha cuts, Representation of Fuzzy Sets & Extension Principle for fuzzy sets	1	
		Practicum (Problem)	**1**	
	Text 1: Chapter 1- Sections: 1.1 to 1.4; Chapter 2- Sections: 2.1 to 2.3			
2	2.1	Types of Operations	2	**20**
	2.2	Fuzzy Compliments	2	
	2.3	Fuzzy intersection : t -norm	2	
	2.4	Fuzzy union : t co-norm	2	
		Practicum (Problem)	**2**	
	Text 1: Chapter 3- Sections: 3.1 to 3.4			
3	3.1	Crisp versus Fuzzy Relations	3	**20**
	3.2	Binary Fuzzy Relations	3	
	3.3	Binary Relation on a single set	3	
	3.4	Fuzzy Equivalence Relations& CompatibilityRelations	3	

		Practicum (Problem)	**3**	
	Text 1: Chapter 5- Sections: 5.1, 5.3 to 5.6			
4	4.1	Graph theory Revisited: Definition, Subgraph, connectivity, cut vertex, cut edge.	4	**15**
	4.2	Fuzzy graph with Example	4	
	4.3	Different types of Fuzzy Graphs withExamples	4	
	4.4	Connectivity in Fuzzy Graphs, Fuzzy Bridgeand Fuzzy Cut vertex with examples	4	
	4.5	Complete Fuzzy Graphs with examples	4	
		Practicum (Problem)	4	
	Text 2: Chapter 2- Sections: 2.1, 2.2, 2.2.1(proof is included)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
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Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Lecture, Teaching, Interactive Instruction, Seminar, Group Assignment,Library Work and Group Discussion		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark**

<table>
<tr><td rowspan="11">Assessment Types</td><td></td><td colspan="4"></td><td>Distribution</td></tr>
<tr><td></td><td colspan="4">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td></td><td colspan="4">Quiz in any mode</td><td>5 Marks</td></tr>
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<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Klir, George J., Yuan, Bo. *Fuzzy Sets and Fuzzy Logic Theory and Applications*,Pearson India Education services Pvt Ltd, 2015.
2. Sunil Mathew., John N Modeson., Davendar S Malik. ,*Fuzzy Graph Theory*.Springer,2018.
3. Wilson, Robin J; *Introduction to Graph Theory* 5th ed, Pearson Education Limited ,2010

SUGGESTED READINGS:

1. Hans-Jürgen Zimmermann. Fuzzy Set Theory and Its Applications.
2. Didier Dubois., Henri Prade. Fuzzy Sets and Systems: Theory and Applications.
3. John N. Mordeson, Davender S. Malik. Fuzzy Graphs: Theory and applications.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Theorems 2.8, 2.9, & 2.10
- Lemma 3.1-3.2, Theorem 3.3-3.8, Theorem 3.11-3.13. Theorem 3.16-3.18.
- Problem solving using the methods discussed in the Module 3.

Discipline Specific Elective – DSE

Exploring the Harmony of Automata

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Exploring the Harmony of Automata**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT5DSE303**					
Course Level	**300**					
Course Summary	The principles acquired in Automata Theory lay a robust groundwork, imparting the skills to effectively address real-life challenges by cultivating the ability to formulate mathematical models for problem- solving. Additionally, this knowledge serves as a springboard for advanced studies in theoretical computer science, algorithm design, and related disciplines.					
Semester	**5**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites,If any	Set Theory					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, the student will be able to		1
1	To Provide Basic Grounding in Discrete Mathematics.	U	1,2
2	To Connect Regular Expression, languages andAutomata.	A	1,2
3	To develop the skills to categorise the differenttypes of mathematical models of computation.	S	1,5,6

4	To handle real-life problems and develop the skill of solving problems through the application of mathematical models and algorithms.	I	1,4,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Automata, Computability and Complexity.	1	**15**
	1.2	Mathematical Notations and Terminology-Sets, Sequences and Tuples	1	
	1.3	**e)** Relations, Functions and Graphs.	1	
	1.4	f) Strings, Languages, Boolean Logic.	1	
		Practicum (Problem)	1	
	Text 1: Sections: 0-0.1 & 0.2.			
2	2.1	Regular Languages: Finite Automata	2	**20**
	2.2	Non-Determinism	2	
	2.3	Regular Expressions	2	
	2.4	Non-Regular Languages	2	
		Practicum (Problem)	**2**	
	Text 1: Sections: 1.1 to 1.4			
3	3.1	Context Free Languages: Context FreeGrammars	3	**20**
	3.2	Pushdown Automata	3	
	3.3	Non-Context free Languages	3	

		Practicum (Problem)	3	
	Text 1: Sections: 2.1 to 2.3			
4	4.1	Church Turing Thesis: Turing Machine	4	**20**
	4.2	Variants Of Turing Machine	4	
	4.3	Enumerators	4	
	4.4	Equivalence with Other Models	4	
		Practicum (Problem)	4	
	Text 1: Sections: 3.1 & 3.2			

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Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Lecture, Teaching, Interactive Instruction, Seminar, Group Assignment,Library Work and Group Discussion		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	Mark Distribution
		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks
	B	**Semester End Examination (Written)**	

Assessment Types		Question Pattern [Maximum Time 2 Hours, Maximum Marks 70]				
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Michael Sipser.. *Introduction to the Theory of Computation.* Thomson PublishingCo,3rd Edition, 2012.

SUGGESTED READINGS:

1. Hop Croft, J.E., Motwani, R., Ullman, J. D. *Introduction to Automata Theory,Languages and Computation*,3rd Edition Pearson, 2008.

2. Lewis, H. R., Papadimitriou, C. H. *Elements of the Theory of Computation.* 2ndEdition, Prentice Hall, 1998.

3. Kozen, C., *Automata and Computability*, Springer-Verlag, 1997

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Problem discussions of the concepts in module 1, 2 and 3
- Discussion of real life problems related to the topics in module 4

Discipline Specific Elective – DSE

Operations Research

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B.Sc. Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Operations Research</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT5SEC300</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications</td></tr>
<tr><td>Semester</td><td>5</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Basic Algebra</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Express objective function and resource constraints in LP model in terms of decision variables andparameters.	U	1,2,3,4
2	Solve an LP problem by the graphical method.	A	1,4,5,6

3	Interpret the optimal solution of LP problems.	A	1,2,3,4,5,6
4	Formulate the dual LP problem and understand therelationship between primal and dual LP problems.	U	1,5,6
5	Recognize, formulate, and solve a transportation problem involving a large number of shipping routes.	C	1,2,3,4,5,6
6	Analyse assignment problem and apply theHungarian method to solve an assignment problem.	C	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO NO:	Hours
1	1.1	Linear Programming: Introduction, Formulationof LPP (Example up to 2.6.10)	1	12
	1.2	Graphical Method of Solution (Example up to 2.9.8)	2	
	1.3	**a)** Some Exceptional Cases	2	
	1.4	b) The General LPP, Canonical and StandardForms of LPP	1	
	Text 1: Chapter 2 - Sections: 2.1, 2.6, 2.9 to 2.12			
2	2.1	Simplex Method: Theory of Simplex Method,Some Important Definitions	3	18
	2.2	The Simplex Method (Example up to 2.16.4)	3	
	2.3	Artificial Variable Techniques: Big-M Method only (Example up to 2.17.4)	3	
	2.4	Special Cases in Simplex Method Application	3	
	2.5	Duality in Linear Programming	4	

	Text 1: Chapter 2 - Sections: 2.13, 2.14, 2.16, 2.17, 2.18.1 to 2.18.6; Chapter 6 - Sections: 6.1.1 to 6.1.3(problems, theorems without proof)			
3	3.1	Transportation Problem: Introduction to the Model, Assumptions in the Transportation Model, Definitions of the Transportation Model, Matrix Terminology	5	**16**
	3.2	Formulation and Solution of TransportationModel	5	
	3.3	Variants in Transportation Problem	5	
	Text 1: Chapter 3 - Sections: 3.1 to 3.4, 3.5.1,3.5.2, 3.6.1,3.6.2			
4	4.1	Assignment Problem: Definition of the Assignment Model, Mathematical Representation of Assignment Model, Comparison with the Transportation Model	6	**14**
	4.2	Solution of the Assignment Model	6	
	4.3	Hungarian Method for Solution of theAssignment Problems	6	
	4.4	Formulation and Solution of the AssignmentModel	6	
	4.5	Variation of Assignment Problem: Non-squareMatrix and Maximization Problem	6	
	Text 1: Chapter 4 - Sections: 4.1 to 4.7			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

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<tr><td rowspan="11">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="8"></td><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Prem Kumar Gupta., Hira, D.S. *Operations Research – 7th Edition*, S Chand & SonsPublications, 2014.

SUGGESTED READINGS:

1. Sharma, J.K. *Operations Research: Theory and Applications – 6th edition,*Macmillian India Ltd-New Delhi Publications
2. Frederick S. Hillier., Gerald J Lieberman. *Introduction to Operations Research* – 10thedition. McGraw Hill Publications.
3. Taha , Hamdy A. *Operations Research: An Introduction – 8th edition.* PearsonEducation Publishers.
4. Kanti Swarup., Gupta, P.K., Man Mohan. *Operation Research*. S Chand & SonsPublications
5. Aumann R.J. *Mixed and Behaviour strategies in infinite extensive.* PrincetonUniversity.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Problem solving using the methods discussed in the module 1, 2 and 3

Semester 6

CourseCode	Title of the Course	Type of the Course	Credit	Hours/ Week
M24MT6DSC300	Mathematical Analysis	Discipline Specific Component - DSC A	4	4
M24MT6DSC301	Fundamentals of Linear Algebra	Discipline Specific Component - DSC A	4	5
M24MT6DSC302	Application of Calculus and Linear Algebra in Finance	Discipline Specific Component - DSC A	4	5
M24MT6DSE300	Introduction Machine Learning Using Python (S)	Discipline Specific Elective - DSE	4	5
M24MT6DSE301	Investment Science	Discipline Specific Elective - DSE	4	5
M24MT6DSE302	Combinatorics	Discipline Specific Elective - DSE	4	5
M24MT6DSE303	Fundamentals of Fluid Dynamics	Discipline Specific Elective - DSE	4	5
M24MT6DSE304	Computations and Graphics Using Scilab	Discipline Specific Elective - DSE	4	5
M24MT6SEC300	Numerical Methods	Foundation Component -VAC	3	3
M24MT6VAC300	Mathematical Computation and Visualization with R	Foundation Component -SEC	3	3

Discipline Specific Component (DSC A)

Mathematical Analysis

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Mathematical of Analysis</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT6DSC300</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">This real analysis course covers the fundamental concepts, includes continuity, uniform continuity, monotone and inverse functions, derivatives, the mean value theorem, L'Hôspital's Rules and Tayler’s theorem. The course also explores the Riemann integral, Riemann integrable functions, and the Fundamental Theorem of Calculus. This curriculum provides students with a solid foundation in calculus and
mathematical analysis, essential for advanced mathematical studies.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Limits and Convergence</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Comprehend the concept of continuous functions and demonstrate proficiency in understanding theirproperties.	U, A	1,2,6
2	Understand uniform continuity, comparing andcontrasting it with continuity.	U	1,2
3	Comprehend the concept of differentiation	U, A	1,2
4	Develop comprehensive understanding of the MeanValue Theorem, L'Hôpital's Rules and Taylor's theorem.	U, A	1,2,3,6
5	Understand the principles of Riemann integration,demonstrating proficiency in applying these concepts	An	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Continuous Functions	1	15
	1.2	Combinations of Continuous Functions	1	
	1.3	Continuous Functions on Intervals	1	
	Text 1: Chapter 5 - Sections: 5.1 (Concepts, statements of the theorems and problems only), 5.2 (Theorems 5.2.4 and 5.2.5 – statements only), 5.3 (Theorems 5.3.4 and 5.3.5 – Statements only)			
	2.1	Uniform Continuity	2	15
	2.2	Monotone and Inverse Functions	2	

2	**Text 1: Chapter 5 - Sections: 5.4 (up to 5.4.8) (Theorems 5.4.2 and 5.4.8 – Statements only), 5.6 (up to 5.6.5). (Theorems 5.6.4 and 5.6.5 – Statementsonly)**			
3	3.1	The Derivative	3	**15**
	3.2	The Mean Value Theorem	4	
	3.3	Intermediate Value Property of Derivatives	4	
	3.4	L'Hospital's Rules	4	
	3.5	Taylor's Theorem	4	
	Text 1: Chapter 6 - Sections: 6.1(up to 6.1.7), 6.2.1 to 6.2.8, 6.2.11 to 6.2.13, 6.3 (Theorems 6.3.3 and 6.3.5- statements only), 6.4.1 to 6.4.3 (Theorem 6.4.1-Statement only)			
4	4.1	Riemann Integral	5	**15**
	4.2	Riemann Integrable Functions	5	
	4.3	The Fundamental Theorem	5	
	Text 1: Chapter 7 - Sections: 7.1, 7.2 (Theorem 7.2.9 – statement only) & 7.3 (up to 7.3.9)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**		
	Lecture, Tutorial and Activity oriented		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks

Assessment Types	B	Semester End Examination (Written)			
		Question Pattern [Maximum Time 2 Hours, Maximum Marks 70]			
		Module	Part A **2 Marks**	Part B **5 Marks**	Part C **10 Marks**	Total
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Bartle, Robert G., Sherbert, Donald R. *Introduction to Real Analysis(4th Edition)*,Wiley Internationals,2002.

SUGGESTED READINGS:

1. Denlinger, Charles. *Elements of real analysis*. Jones & Bartlett Learning, 2011.
2. Howie, John M. *Real analysis*. Springer Science & Business Media, 2006.
3. Abbott, Stephen. *Understanding analysis*. springer publication, 2015.
4. Ghorpade, Sudhir R., and Balmohan Vishnu Limaye. *A course in calculus and realanalysis*. New York: Springer, 2006.
5. Kumar, Ajit, Kumaresan, S. *A basic course in real analysis*. CRC press, 2014.

ADVANCED READINGS:

1. Gelbaum, Bernard R., and John MH Olmsted. *Counterexamples in analysis*. CourierCorporation, 2003.
2. Rudin, Walter. *Principles of mathematical analysis*. Vol. 3. New York: McGraw-hill,1976.

3. Apostol, Tom M. *Mathematical analysis*. 1974.
4. Royden, Halsey Lawrence, and Patrick Fitzpatrick. *Real analysis*. Vol. 2. New York:Macmillan, 1968.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Aproximations
- Piecewise linear functions
- Weierstrass aproximation theorem
- Continuity and gauges
- The nth root function
- Rational powers.
- Further applications of the Mean Value Theorem and inequalities.
- Proofs of L'Hospital's Rules
- Point-wise and uniform convergence
- Proof of all theorems of Section 5.1, theorems 5.2.4, 5.2.5, 5.3.4 and 5.3.5.
- Proof of theorems 5.4.2, 5.4.8, 5.6.4 and 5.6.5.
- Proof of theorems 6.3.3 and 6.3.5.
- Proof of theorem 7.2.9.

Discipline Specific Component (DSC A)

Fundamentals of Linear Algebra

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Fundamentals of Linear Algebra</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT6DSC301</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">Linear Algebra is a fundamental tool in many areas of mathematics, science, engineering, economics, and data science. It also has applications in machine learning, providing the mathematical foundation for many algorithms and techniques. This course on Linear Algebra deals with the basic concepts like vector spaces, linear transformations, determinants, Eigen values and Eigen vectors.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Algebra of Matrices, Gaussian Elimination Method, Solution andconsistency of system of linear equations.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Analyse the basic concepts of vector spaces	An	1,2,3
2	Illustrate the fundamental properties of lineartransformations	A	2,3
3	Compute the eigen values and eigen vectors	A	1,3
4	Deduce the connections between determinants andother linear algebra concepts	An	1,2,3
5	Apply computational software and tools in linearalgebra computations.	A	2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Vector Spaces: Definition and examples	1	20
	1.2	Subspaces	1	
	1.3	Linear Combination of Vectors, Spanning Set, Linear Dependence and Independence of Vectors	1	
	1.4	Basis of a Vector Space	1	
	1.5	Dimension of a Vector Space	1	
		Problems (Practicum)	1	
	Text 1: Chapter 5			
	2.1	Linear Mappings	2	

2	2.2	Kernel and Range of a Linear Mapping	2	**20**
	2.3	Bijective Linear Mappings	2	
	2.4	Dimension Theorem	2	
	2.5	Rank and Nullity	2	
	2.6	Linear Isomorphism	2	
		Problems (Practicum)	2	
	Text 1: Chapter 6.			

3	3.1	Eigen Values and Eigen Vectors	3	**20**
	3.2	Characteristic Polynomial, Characteristic Equation and Algebraic Multiplicity	3	
	3.3	Eigen Space and Geometric Multiplicity	3	
	Text 1: Chapter 9 (up to and including theorem 9.2)			
4	4.1	Determinantal Mapping	4	**15**
	4.2	Determinant of a Matrix as a DeterminantalMapping	4	
	4.3	Laplace Expansion	4	
	4.4	Adjoint and Inverse of a Matrix	4	
		Problems (Practicum)	4	
	Text 1: Chapter 8 [Theorems(Statements only) and applications.]			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem Solving Skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lectures, Tutorials, Interactive Sessions, Blended Learning</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="4"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
</table>

		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Blyth, T. S., and E. F. Robertson. *Basic linear algebra*, Second Edition, Springer,2007.

SUGGESTED READINGS:

1. Strang, Gilbert. *Introduction to linear algebra (5th ed.)*. Wellesley-Cambridge Press,2016.
2. Lay, D. C. *Linear algebra and its applications* (5th ed.). Pearson Education, 2018.
3. Axler, S. *Linear algebra Done Right* (3rd ed.). Springer, 2015.
4. Hoffman, K., & Kunze, R. *Linear algebra* (2nd ed.). Prentice Hall, 2009.
5. Lipschutz, S., Lipson, M. *Schaum's outline of theory and problems of linear algebra* (4th ed.). McGraw-Hill, 2009.
6. Thamban Nair, M., Singh, A. *Linear Algebra*. Springer, 2018.
7. Anton, H. *Elementary linear algebra* (12th ed.). Wiley, 2019.
8. Kumaresan, S. *Linear Algebra: A Geometric Approach*. PHI Learning, 2015.
9. Bronston, T. A., Costa, A. C. R. *Linear algebra: An introduction* (4th ed.),AcademicPress, 2013.
10. Video lectures of Gilbert Strang hosted by MITOpenCourseWare available at https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/video_galleries/video-lectures/

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Proofs of theorems in Module 4
- Use of computational software or tools (like Python, Sagemath etc.) to performcomputations in the modules 1 to 4 efficiently

Discipline Specific Component (DSC A)

Applications of Calculus and Linear Algebra in Finance

<table>
<tr><td></td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B.Sc. Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Applications of Calculus and Linear Algebra in Finance</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT6DSC302</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">The goal of this course is to give the students a deeper understanding and working Knowledge of the application of mathematical concepts in Economic Analysis, via more sophisticated, realistic, and interesting models.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">A deeper understanding of mathematical Analysis and Algebra</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Apply the concept of single variable and several variable calculus to the problems in Economics.	A	1,2,3,4

2	Analyse the money market and goods market andunderstand the trading strategy and use it effectively	An	1,2,3
3	Create an optimum solution in terms of productivityand profitability for economic problems	C	1,2
4	apply Pareto optimality conditions	A	1,2,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Application of Calculus in Finance**		**15**
	1.1	Production Functions, Cost Functions, Revenue and Profit Functions, Demand Functions and Elasticity **(Practicum)** **Exercise problems (Text 1)**	1	
	1.2	Base10Logarithms, Base e Logarithms, PresentValue, Annuities, Optimal Holding Time	1	
	1.3	Economic Interpretation, Marginal Products, Elasticity, Geometric Interpretation, an application of higher derivatives in economics, Exercise problems of section 3.6,14.3,14.8 **(Practicum)** **Problems on Elasticity Text II (section 7.7 Exercise)**	1	
	1.4	System of implicit function (proof excluded) Comparative statics, Simpson's paradox, Exercise problems **(Practicum)** **Exercise Problems of section 15.4 text I, Problems related to Comparative statics Text II (section 13.7)**	1	

	Text 1: Chapter 3- Section: 3.6; Chapter 5- Sections: 5.3, 5.6; Chapter 14- Sections: 14.2, 14.3, 14.8(An Economic application); Chapter 15- Sections: 15.3, 15.4 & 15.6			
2		**Linear Algebra in Finance**		**20**
	2.1	**EXAMPLES OF LINEAR MODELS** Example 1: Tax Benefits of Charitable Contributions, Example 2: Linear Models of Production, Example 3: Markov Models of Employment, Example 4: IS-LM Analysis, Example 5: Investment and Arbitrage	2	
	2.2	Application to Portfolio Theory, IS-LM analysisvia Cramer'S Rule **(Practicum)** **Exercise problems Text1 section 9.3**	2	
	2.3	Budget Sets in Commodity Space, Input Space,Probability Simplex	2	
	2.4	The Investment Model, IS-LM Analysis, Supplydemand **(Practicum)** **Exercise 10.42 Text 1(Section 10.7)**	2	
	Text 1: Chapter 6- Section: 6.2; Chapter 7- Section: 7.4(Application to Portfolio Theory); Chapter 9- Section:9.3; Chapter 10- Section: 10.7; Chapter26- Section: 26.4			
3		**Optimization in Finance**		**20**
	3.1	Quadratic forms, Definiteness of Quadraticforms, : Second Order Conditions and Convexity, Conic Sections, The Definiteness ofDiagonal Matrices The Definiteness of 2 X 2 Matrices	3	
	3.2	Definiteness and Optimality One Constraint, Other Approaches, Profit-Maximizing Firm, Discriminating Monopolist, Least Squares Analysis **(Practicum)**	3	

		Exercise of section 16.3 Text 1		
	3.3	Homogeneous Function, Definition and Examples, Homogeneous Functions in Economics, Properties of Homogeneous Functions, A Calculus Criterion for Homogeneity	3	
	3.4	Economic Applications of Euler's Theorem, Homogenizing a Function, Economic Applications of Homogenization, cardinal versus ordinal utility	3	
	Text 1: Chapter 16- Sections: 16.1 to 16.3; Chapter 17- Section: 17.5; Chapter 20- Sections: 20.1 to 20.3			
4		**Advanced Calculus in Finance**		**20**
	4.1	Concave functions in Economics, quasi concaveand quasi convex Functions, Calculus Criteria, Pseudo concave functions,	4	
	4.2	Concave programming-Unconstrained Problems,Constrained Problems, Saddle Point Approach **(Practicum)** **Exercise of section 21.5 Text 1**	4	
	4.3	Utility Maximization, The Demand Function, The Indirect Utility Function, The Expenditure and Compensated Demand Functions, The Slutsky Equation, profit and cost, The Proft-Maximizing Firm, The Cost Function	4	
	4.4	Necessary Conditions for a Pareto OptimumSufficient Conditions for a Pareto OptimumThe Fundamental Welfare Theorems Competitive Equilibrium, Fundamental Theorem of Welfare Economics	4	

	Text 1: Chapter 21- sections: 21.2(Concave functions in Economics)21.3 to 21.5; Chapter 22- sections: 22.1 to 22.4(proof of theorems from all sectionsexcluded)
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**		
	Lecture, Teaching, Interactive Instruction, Seminar, Group Assignment,Library Work and Group Discussion		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	Mark Distribution

Assessment Types		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks
	B	**Semester End Examination (Written)**	
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**	

Module	Part A	Part B	Part C	Total
	2 Marks	**5 Marks**	**10 Marks**	
I	3	2	1	**6**
II	3	3	1	**7**
III	3	2	1	**6**
IV	3	2	1	**6**
Total no of questions	**12**	**9**	**4**	**25**

		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Carl P. Simon and Lawrence, Mathematics for Economists, Blume Viva Books, 2018
2. Prof. Knut Sydsaeter,Prof. Peter Hammond Prof. Arne Strom, Essential Mathematicsfor Economic Analysis (4th Edition), Pearson Publication, 2012.

SUGGESTED READINGS:

1. Chiang, C., Fundamental Methods of Mathematical Economics, McGrawHills, *(Latest Edition).*
2. Budnick, Frank, Applied Mathematics for Business, Economics and Social Sciences,McGraw Hills Education, 2017..
3. Dowling E. T., Mathematics for economists, Schum Series (latest edition)
4. Rosser, Mike, Basic Mathematics for Economists, Routledge, Taylor & FrancisGroup, 2003.

ADVANCED READING:

1. Weber E. Jean, Mathematical Analysis, Business and Economic Applications (LatestEdition) Harper and Row Publishers, New

Discipline Specific Component (DSC E)

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Introduction to Machine Learning using Python</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Component (DSC A)</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT6DSE300</td></tr>
<tr><td>Course Level</td><td colspan="6">300</td></tr>
<tr><td>Course Summary</td><td colspan="6">Machine Learning is one of the most sought after domain in Computer Science. It has immense applications in almost all fields of study. Banking, Insurance, Travel and Tourism, Medicine, Education, Logistics & Supply Chain, E-commerce and Computer games are to name a few. This course Introduction to Machine Learning using Python provides detailed information about different types of learning, the concepts of different types of regression, classification algorithms and clustering. This course also provides a hands-on experience to implement the core concepts of machine learning using Python.</td></tr>
<tr><td>Semester</td><td></td><td colspan="3">Credits</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites,If any</td><td colspan="6"></td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand the difference between traditional programming & machine learning, different types of machine learning and challenges in machine learning.	U	1,2,3
2	Understand, analyze and apply different types of regression.	U, A, An	2,4,5
3	Understand, analyze and apply different types of classification algorithms.	U, A, An	1,2,3,4
4	Understand, analyze and apply different types of clustering algorithms.	U, A, An	1,2,3,5,6
5	Analyse, apply and evaluate the most appropriate machine learning concept from case studies.	An, A, E	1,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	What is Machine Learning? Machine Learning Vs. Traditional Programming How Machine Learning Works?	1	**15**
	1.2	Applications of Machine Learning	1	
	1.3	Types of Learning - Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Reinforcement Learning, Active Learning	1	
	1.4	Challenges in Machine Learning	1	
		Problems (Practicum)		
	Text 1: Chapter 1			

2	2.1	Introduction, Types of Regression	2	**15**
	2.2	Simple Linear Regression	2,5	
	2.3	Multiple Linear Regression	2,5	
	2.4	Non-linear Regression(Polynomial Regression)	2,5	
	2.5	Logistic Regression	2,5	
		Problems (Practicum)	2,5	
	Text 1: Chapter 2			
3	3.1	Introduction to classification	3	**25**
	3.2	Decision Trees	3,5	
	3.3	Naïve Bayes classification	3,5	
	3.4	Support Vector Machines	3,5	
	3.5	K-Nearest Neighbours	3,5	
	3.6	Random Forest	3,5	
	Text 1: Chapter 3			
4	4.1	Introduction, Requirements of Clustering	4	**20**
	4.2	Types of Data in Cluster Analysis - Interval-Scaled Variables, Binary Variables, Categorical Variables, Ordinal Variables, Ratio-Scaled Variables, Variables of Mixed Types	4	
	4.3	Categorization of Major Clustering Methods - Partitioning Methods - K-means	4,5	
	4.4	Hierarchical Methods - Agglomerative Clustering	4,5	
	4.5	Density-based Methods – DBSCAN	4,5	
	Text 1: Chapter 4			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. as specified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.

It's purpose is to encourage creativity and develop Problem Solving Skills.

The practicum component is to be done in the classroom under the strict guidance of the teachers.

A minimum of 1 problem is to be solved from each machine learning concept, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td rowspan="15">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="9"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Jeeva Jose, Introduction to Machine Learning using Python, Khanna Publishers, New Delhi, 2020

SUGGESTED READINGS:

12. Manaranjan Pradhan, U Dinesh Kumar, Machine Learning using Python, Wiley, 2019.
13. S. Sridhar, M. Vijayalakshmi, Machine Learning, Oxford University Press, 2021.
14. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory To Algorithms, Cambridge University Press, 2015.

WEB RESOURCES:

- https://www.javatpoint.com/machine-learning
- https://www.geeksforgeeks.org/machine-learning/
- https://www.simplilearn.com/tutorials/machine-learning-tutorial
- https://www.tutorialspoint.com/machine_learning/index.htm

Discipline Specific Elective – DSE

Investment Science

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Investment Science**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT6DSE301**					
Course Level	**300**					
Course Summary	This course is an introduction to the application of mathematics in financial world, that enables the student to understand some computational and quantitative techniques required for working in the financial markets and actuarial mathematics					
Semester	**6**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**4**
Pre- requisites, If any						

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Calculate simple and compound interest for discreteand continuous cases.	A	1,2
2	Learn about time value of money, bond prices andyields	E	1,2,3

3	Describe asset return, short selling, portfolio returnetc	S	1
4	Describe capital market line, security market lineetc.	U	1

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Basic principles: Comparison, arbitrage and riskaversion,	1	**15**
	1.2	Interest (simple and compound, discrete andcontinuous), Interest rates	1	
	1.3	Present value analysis	1	
	1.4	Rate of return, continuously varying interestrates**.**	1	
		Practicum(Problem)	**1**	
2	2.1	Time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods)	2	**15**
	2.2	Comparison of NPV and IRR. Bonds, bond prices and yields, Macaulay and modified duration	2	
	2.3	**T**erm structure of interest rates: spot and forward rates	2	
	2.4	Explanations of term structure, running present value, floating-rate bonds, immunization,convexity, putable and callable bonds	2	
		Practicum(Problem)	**2**	

3	3.1	Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation).	3	**15**
	3.2	Random returns, portfolio mean return andvariance	3	
	3.3	Diversification, portfolio diagram, feasible set.	3	
	3.4	Markowitz model (review of Lagrangemultipliers for 1 and 2 constraints)	3	
		Practicum(Problem)	**3**	
4	4.1	Two fund theorem, risk free assets, One fundtheorem.	3	**15**
	4.2	Capital market line, Sharpe index. Capital AssetPricing Model (CAPM).	4	
	4.3	Betas of stocks and portfolios, security marketline.	4	
	4.4	use of CAPM in investment analysis and as apricing formula, Jensen's index	4	
		Practicum(Problem)	**4**	
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
It's purpose is to encourage creativity and develop Problem Solving Skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching	**Classroom Procedure (Mode of transaction)**

<table>
<tr><td>andLearning Approach</td><td colspan="6">Lecture, Teaching, Interactive Instruction, Seminar, Group Assignment,Library Work and Group Discussion</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="3"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
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<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
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</table>

REFERENCES:

1. David G. Luenberger. *Investment Science*, Oxford University Press, Delhi,1998.
2. John C. Hull. *Options, Futures and Other Derivatives (6th Edition*), Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross. *An Elementary Introduction to Mathematical Finance (2ndEdition)*, Cambridge University Press, USA, 2003.
4. Kevin J Hastings. *Introduction to Financial Mathematics*, CRC Press, 2015.

Discipline Specific Elective – DSE

Combinatorics

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP** **SYLLABUS**					
Programme	**B.Sc.** **Mathematics**					
Course Name	**Combinatorics**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT6DSE302**					
Course Level	**300**					
Course Summary	This course is a dynamic exploration of fundamental combinatorial concepts, focusing more on problems than theory. This approach aims to help students excel in competitive examinations by thoroughly covering exercise problems**.**					
Semester	**6**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites,If any	Elementary Algebra, Basic Set theory, Basic understanding of Probability theory					

COURSEOUTCOMES(CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Provides a valuable toolkit for students preparing for competitive exams, offering a wealth of problems that sharpen logical reasoning and problem-solving skills	S	1,2,3
2	Apply combinatorial methods to model and analyse real-world problems, emphasizing the translation of problems into mathematical language	A n	1,2,3
3	Demonstrate a deep understanding of basic combinatorial concepts, such as permutations, combinations, and the multiplication principle	U	1
4	Develop critical thinking skills by analysing and synthesizing complex combinatorial problems, evaluating different approaches, and selecting the most suitable strategies.	I	1,2,3,4, 5
Remember(K),Understand(U),Apply(A),Analyse(An),Evaluate(E),Create(C),Skill(S), Interest (I) and Appreciation (Ap)			

COURSECONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Two basic counting principles	1,2,4	20
	1.2	Permutations	1,3	
	1.3	Circular permutations	1,3	
	1.4	Combinations	1,3	
		Practicum(Problem)	1,2,3	
	Text 1: Chapter 1- Sections: 1.1 to 1.4			
2	2.1	The injection and bijection principles	1,4	20
	2.2	Arrangements and selections with repetitions	1,3	
	2.3	Distribution Problems	1,3	
		Practicum(Problem)	1,3,4	
	Text 1: Chapter 1- Sections: 1.5 to 1.7			

3	3.1	Introduction	1,2	20
	3.2	The Pigeonhole principle	1,2	
	3.3	More examples	1,2,3	
	3.4	Ramsey Type problems and Ramsey numbers	1,4	
	3.5	Bounds for Ramsey Numbers	1,4	
		Practicum(Problem)	**1,2,3,4**	
	Text 1: Chapter 3 - Sections: 3.1 to 3.5 (Theorems 3.5.1 and 3.5.2 – statementsonly)			
4	4.1	Introduction	1	15
	4.2	The Principle of Inclusion and Exclusion:	1,2	
	4.3	A generalization	1,2,4	
	4.4	Integer solutions and shortest routes	1,2,3	
	4.5	The Sieve of Eratosthenes and Eulerfunction	1	
		Practicum(Problem)	**1,2,3,4**	
	Text 1: Chapter 4 - Sections: 4.1 to 4.4 & 4.7 (Theorem 4.3.1- statement only)			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

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A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching andLearning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td rowspan="12">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern [Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td>Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td><td></td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXTBOOK:

1. Chen, Chuan-Chong, Khee Meng Koh, and Koh Khee-Meng. *Principles andtechniques in combinatorics*. World Scientific, 1992.

SUGGESTED READINGS:

1. Krishnamoorthy, V., Hoewood, E. *Combinatorics theory and applications*, 1986.
2. Hall, Jr. *Combinatorial Theory*, Wiley-Interscinice,1998.
3. Brualdi, RA. *Introductory Combinatorics*, PrenticeHall,1992
4. Bona Miklos. *A Walk Through Combinatorics – An Introduction to Enumeration andGraph Theory*, Second Edition, World Scientific, 2006.

ADVANCED READINGS:

1. Bóna, Miklós, ed. *Handbook of enumerative combinatorics*. Vol. 87. CRC Press,2015.
2. Flajolet, Philippe, and Robert Sedgewick. *Analytic combinatorics*. CambridgeUniversity press, 2009.
3. Harris, John M. *Combinatorics and graph theory*. Springer, 2008.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Binomial coefficients and multinomial coefficients.
- Stirling numbers of first kind
- Stirling numbers of second kind
- Surjective mappings and Stirling numbers of second kind
- Derangements and A generalization
- Proof of theorems 3.5.1 and 3.5.2
- Proof of theorems 4.3.1
- Generating functions
- Recurrence relations

Discipline Specific Elective – DSE

Fundamentals of Fluid Dynamics

<table>
<tr><td></td><td colspan="5">Mar Athanasius College (Autonomous),
Kothamangalam

FYUGP
SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="5">B.Sc.
Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="5">Fundamentals of Fluid Dynamics</td></tr>
<tr><td>Type of Course</td><td colspan="5">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="5">M24MT6DSE303</td></tr>
<tr><td>Course Level</td><td colspan="5">300</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course aims to pave a strong foundation of fluid dynamics. The course is intended to impart knowledge regarding fluids, conservation laws and hence enable students to model basic fluid flow problems. The course begins with introducing the basics of fluid dynamics. The motion of fluids is described using Lagrangian and Eulerian methods. Then the fluid kinematics and the conservation laws are examined. Dimensional homogeneity and dimensional analysis are learned. This enables students to model basic flow problems. This acquired knowledge is used to model one-dimensional flow problems like the Bernoulli’s equation and thereafter enable students to solve laminar flows of viscous incompressible fluids. Some real-life problems are modelled and solved mathematically to arrive at analytical solutions.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,if any</td><td colspan="5"></td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
Upon the successful completion of the course, the student will be able to:			
1	Know the fundamentals of fluid mechanics and fluid motion	U, R	1
2	Learn fluid kinematics and the laws of conservation tomodel fluid flows.	U	1,2,3,4
3	Apply the acquired knowledge to model one-dimensional fluid flow.	A	1,2,3,
4	Analyse the dimensional homogeneity of the physicalequations.	An	1,5,6
5	Model laminar flow of viscous incompressible fluids andarrive at analytical solutions.	An	1,2,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	**Fluids & fluid motion**			**20**
	1.1	Fluid, Isotropy, Fluid Properties.	1	
	1.2	Viscous and Inviscid fluids, Important types offlows.	1	
	1.3	Results of vector analysis.	1	
	1.4	Methods to describe fluid motion: Lagrangianand Eulerian methods.	1	
	1.5	Velocity and acceleration of a fluid particle,Material, local and convective derivatives.	1	
		Practicum(Problem)	1	
	Text 1: Chapter 1 – Sections: 1.1 to 1.6; Chapter 2 – Sections: 2.1 to 2.6.			

2	**Fluid kinematics & Conservation Laws**			**20**
	2.1	Stream line, Path line, Streak line, Stream tube.	1,2	
	2.2	Equation of Continuity (Cartesian form).	2	
	2.3	Equation of Motion (Cartesian form): TheNavier-Stokes equations.	2	
	2.4	The Energy equation.	2	
		Practicum(Problem)	2	
	Text 1: Chapter 2 – Sections: 2.7 to 2.9, 2.20 to 2.25; Chapter 3 – Sections: 3.1 & 3.9.			
3	**One-dimensional flow & dimensional analysis**			**20**
	3.1	One-Dimensional flow: Bernoulli's equation.Bernoulli's Theorem.	3	
	3.2	Flow from a tank through a small orifice:Torricelli's theorem.	3	
	3.3	Dynamical similarity and Inspection analysis:Reynold's principle of similarity.	4	
	3.4	Dimensional analysis using Rayleigh'sTechnique.	4	
		Practicum(Problem)	4	
	Text 1: Chapter 4 – Sections: 4.1, 4.2, 4.4A; Chapter 15 – Sections: 15.1 to 15.5, 15.13 & 15.14.			
4	**Laminar flows of viscous incompressible fluids**			**15**
	4.1	Flow between parallel flat plates: Plane Couetteflow.	5	
	4.2	Couette flow.	5	
	4.3	Plane Poiseuille flow.	5	

		Practicum(Problem)	**5**
	Text 1: Chapter 16 – Sections: 16.1 to16.3D.		
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned.)* **This content will be evaluated internally.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem Solving Skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**					
	Lecture and Tutorial Practical Demonstration Using Appropriate Software.					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			**Mark Distribution**	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**				
		Module	**Part A**	**Part B**	**Part C**	**Total**
			2 Marks	**5 Marks**	**10 Marks**	

		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total numberof questions	**12**	**9**	**4**	**25**
		Number of questions to beanswered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Raisinghania, M.D. *Fluid Dynamics: With Complete Hydrodynamics and BoundaryLayer Theory*, Eleventh Revised Edition, S. Chand and Company Ltd, 2013.

SUGGESTED READINGS:

1. Yuan, S.W. *Foundations of Fluid mechanics*, Prentice Hall of India, 2001.
2. Chandrasekharaiah, D. S., Debnath, L. *Continuum Mechanics*, Academic Press, 2014.
3. Batchelor, G.K. *An Introduction to Fluid Dynamics*, Cambridge University Press,2000.
4. Kundu, P.K., Cohen., I.M., Dowling D.R. *Fluid Mechanics*, Fifth Edition, 2012.

ADVANCED READINGS:

1. White, F.M. *Fluid Mechanics*, Tata Mc Graw Hill, 2011.
2. Schlichting, H. *Boundary Layer Theory*, Tata Mc Graw Hill, 2002.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Classify different types of fluids and draw a graph to differentiate Newtonian andnon-Newtonian fluids.
- Visualize the streamline of a fluid flow for an instantaneous velocity using WolframAlpha.
- Represent the velocity and acceleration of a moving fluid particle

using Sci-labsoftware.

- Inspect the dimensional homogeneity of some well-known physical equations.
- Visualize the Couette flow using MATLAB software.
- Compare the importance of Boundary layer flows and Viscous laminar flows.

Discipline Specific Elective – DSE

Computations and Graphics using Scilab

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Computations and Graphics using Scilab**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT6DSE304**					
Course Level	**300**					
Course Summary	The course is designed for doing computations, matrix operations, solving system of linear equations, plotting data, visualisation of curvesand solving differential equations using Scilab.					
Semester	**6**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre- requisites, If any	Fundamental knowledge on algebraic equations, mathematical functions,matrices, differential equations.					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand the basic commands used f	U,S	1,2,5,6
2	Apply basic programming techniques in Scilab tocompute the value of expressions involving mathematical functions.	A,S	3

3	Apply Scilab to do various operations in Matricesand solving system of linear equations.	A,S	1
4	Apply Scilab to plot various mathematical functions, expressions and solving differential equations.	A,S	1,2,5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	The General Environment and Console, SimpleNumerical Calculations	1	**15**
	1.2	The Menu bar, The Editor	1,2	
	1.3	The Graphics Window (Graphics for Plotting,Modifying a Plot, Online help), Windows Management and Workspace Customization	4	
		Practicum(Problem)	**1,2,4**	
	Text 1: Chapter 1 – Become Familiar with Scilab			
2	2.1	Variables Assignment and Display (Variables,Functions)	1	**20**
	2.2	Variables Assignment and Display (Display -Brackets : Vectors and Matrices, Strings)	1,2	
	2.3	Loops – for, while, Tests – if.. then.. else.. Tests	1,3	
		Practicum(Problem)	**1,2,3**	
	Text 1: Chapter 2 – Programming – sections: Variables Assignments and Display to Tests			
3	3.1	2 D and 3D Plots (Basic Plots - of MathematicalFunctions, Plots of Plane	4	

		Curves)		
	3.2	2 D and 3D Plots (Plots of Sequence of Points,Bivariate Statistical Data)	4	**20**
	3.3	2 D and 3D Plots (Plots in 3 dimensions – surfaces and curves)	4	
	3.4	2 D and 3D Plots (Simulations and Statistics,Statistics - Plotting Data using Bar graphs)	5	
		Practicum(Problem)	**4,5**	
	Text 1: Chapter 2 – Programming – sections: 2 D and 3D Plots			
4	4.1	Additional Information on Matrices and Vectors(Accessing Elements, Operations on Matrices)	3	
	4.2	Additional Information on Matrices and Vectors(Solving Linear Systems, Some useful Functions - sort, length, sum and product)	3	
	4.3	Additional Information on Matrices and Vectors(Some useful Functions - unique, find) Accuracy Computation Solving Differential Equations	2, 4	**20**
		Practicum(Problem)	**2,3,4**	
	Text 1: Chapter 2 Programming – sections: Additional Information onMatrices and Vectors to Solving Differential Equations			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
It's purpose is to encourage creativity and develop Problem Solving Skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Interactive Instructions using ICT Tools
Hands on Training</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td></td><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td></td><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td></td><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td></td><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td></td><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td></td><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td></td><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
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</table>

		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. https://www.scilab.org/sites/default/files/Scilab_beginners.pdf

SUGGESTED READINGS:

1. https://scilab.in/textbook_companion/generate_book/845
2. https://www.scilab.org/sites/default/files/progscilab-v.0.10_en.pdf

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

1. Text 1 : Chapter 3 Useful Scilab Functions (Analysis, Probability and Statistics,Display and Plot, Utilities)

Foundation Component - SEC
Numerical methods

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. Mathematics**
Course Name	**Numerical methods**
Type of Course	**Foundation Component - SEC**
Course Code	**M24MT6SEC300**
Course Level	**300**
Course Summary	Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of systems of linear equations and differential equations, interpolation, differentiation, evaluating integration.

Semester	**6**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		4	0	0	0	**4**
Pre- requisites, If any						

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, the student will be able to		
1	Find the consequences of finite precision and the inherent limits of numerical methods	E	1,2,5,6
2	Find appropriate numerical methods to solve algebraicand transcendental equations.	,E	3,4,
3	Use numerical methods to find missing values of data.	A	1,2,6
4	Apply numerical methods to solve real life problems	C	1,2,3,4,5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO NO:	Hours
1	1.1	Numerical Analysis: Mathematical Preliminaries, Errors and Their Computations.	1	15
	1.2	Introduction, Bisection Method, Method of False Position.	2,3	
	1.3	Iteration Method, Newton - Raphson Method	2,3	
	Text 1: Chapter 1 - Sections: 1.2 to 1.3; Chapter 2 – Sections: 2.1 to 2.5.			
2	2.1	Interpolation: Finite Differences, Differences ofa polynomial.	4	15
	2.2	Newton's Formulae for Interpolation.	3,4	
	2.3	Central Difference: Gauss's Central differenceformulae.	4	
	Text 1: Chapter 3 - Sections: 3.3,3.5,3.6 & 3.7.1			
3	3.1	Interpolation with Unevenly Spaced Points:Lagrange's Interpolation Formula.	3,4	15
	3.2	Divided Differences and Their Properties.	3,4	
	3.3	Inverse Interpolation.	3,4	
	Text 1- Chapter 3 - Sections: 3.9.1, 3.10 & 3.11			
4	4.1	Numerical differentiation and Integration: Numerical differentiation, Errors in NumericalDifferentiation.	1,3	15
	4.2	Differentiation Formulae with Function Values.	2,4	
	4.3	Numerical integration: Trapezoidal Rule,Simpson's 1/3- rule, Simpson's 3/8- rule.	4	

	Text 1- Chapter 6 - Sections: 6.2.1,6.2.3, 6.4.1 to 6.4.3					
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**					
Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**					
	Lecture, Teaching, Interactive Instruction, Seminar, Group Assignment,Library Work and Group Discussion					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			Mark Distribution	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**				
		Module	Part A **2 Marks**	Part B **5 Marks**	Part C **10 Marks**	Total
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Sastry, S. S. *Introductory methods of Numerical Analysis,5th edition,*

PHI LearningPrivate Limited, 2013.

SUGGESTED READINGS:

1. Jain, M. K., Iyengar, S. R. K., & Jain R. K. Numerical Methods for *Scientific and Engineering Computation (6th ed.)*. New Age International Publishers. Delhi, 2012.
2. Bradie, Brian. *A Friendly Introduction to Numerical Analysis*. Pearson EducationIndia, 2006.
1. Chapra, Steven C. *Applied Numerical Methods with MATLAB for Engineers andScientists (4th ed.).* McGraw-Hill Education, 2018.
2. Fausett, Laurene V. *Applied Numerical Analysis Using MATLAB*. Pearson. India,2009.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Problem solving using the methods discussed in the module 1, 2, 3 and 4. Extra reading and practice: Stirling's formula, Bessel's formula, Boole's andWeddle's

Foundation Component - VAC

Mathematical Computation and Visualization with R

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Mathematical Computation and Visualization with R**					
Type of Course	**Foundation Component - VAC**					
Course Code	**M24MT6VAC300**					
Course Level	**300**					
Course Summary	This course delves into the realm of mathematical computation and visualization using the powerful R programming language. Students will embark on a journey through the fundamentals of R, exploring its functionality and applications in various mathematical domains.					
Semester	**6**	**Credits**			**3**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	0	0	**3**
Pre-requisites,If any	Nil					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course,the student will be able to		
1	Apply R to represent and manipulate sets, including operations like union, intersection, and difference	U	1,2
2	Apply matrix concepts to represent and solve system of linear equations in R	A	1
3	Solve various matrix operations.	A	2
4	Compute determinants of matrices using R & employ Cramer's rule to solve system of linear equations in R	A	1,3,4,
5	Apply R to analyse functions	A	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**R FUNCTIONS AND AN OVERVIEW OFSETS USING R**		**15**
	1.1	Functions, Parameter versus Argument, Argument Order and Parameter Names, Environments, Scope	1	
	1.2	Sets, Venn diagram, Cardinality of sets, Implementing the Subset Function in R, Equalityof Sets, Empty Set.	1	
	1.3	Operations on Sets – Intersection, Union,Complement, Cross Product of	1	

		two sets.		
	Text 1: Chapter 1 - Sections: 1.2 to 1.6; Chapter 3- Sections: 3.1 to 3.9 & 3.11.			
2		**SYSTEM OF LINEAR EQUATIONS ANDMATRICES IN R**		
	2.1	Matrix & Vector in R	2	**15**
	2.2	Solving a System of Linear Equations with R (Gaussian Elimination in R)	2	
	2.3	Matrix Operations in R - Addition, Scalarmultiplication, Dot product, Transpose	3	
	2.4	Determinant, function, Cramer's rule in R	4	
	Text 2: Chapter 1 – *Sections*: 1.2.3, 1.2.7, 1.3.3, 1.3.7; Chapter 2 - Sections: 2.1, 2.2(2.2.1-2.2.3 & 2.2.7); Chapter 3 - Sections: 3.3 det( ) function only , 3.3.4 {lab exercises using det( ) function}, 3.5.3 & 3.5.7.			
3		**PLOTTING GRAPHS IN R**		
	3.1	Basic arithmetic, Define and Evaluate a Function, Graph a Function in R, Find Roots of a Function, Store Roots as a Variable and Display the First Root, Evaluate a Function with a Variable, Add a Point to a Graph, Evaluate a Function at Multiple Values, Add Multiple Points to a Graph	5	**15**
	3.2	Define a Function from a Function, Define a Function and Graph It, Identify Intersection Points and Add Them to the Graph, Add a Line Segment to a Graph	5	
	Text 3: Chapter 1 (R codes 1.1 to 1.20),			

4	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="5">The primary goal of this class is to enhance students' proficiency in mathematical computation and visualization using the R programming language. The course will cover fundamental mathematical concepts andtheir practical implementation through R.

Class Structure:
1. Introduction - Outline the goals and expectations for the class
2. Recap and Review - Briefly review the key concepts covered
3. Theory and Conceptual Understanding - Discuss theoreticalaspects and provide real-world examples
4. Hands-On Computation with R - Conduct practical exercisesusing R to reinforce mathematical concepts
5. Group Project - Assign a group project

Homework Assignment - Assign relevant homework to reinforce learning</td></tr>
<tr><td rowspan="7">Assessmen tTypes</td><td colspan="5">MODE OF ASSESSMENT</td></tr>
<tr><td rowspan="3">A</td><td colspan="4">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td colspan="3">Component s</td><td>Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td>20 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td>5 Marks</td></tr>
<tr><td rowspan="4">B</td><td colspan="4">Semester End Examination (Written)</td></tr>
<tr><td colspan="4">Question Pattern
[Maximum Time 90 Minutes, Maximum Marks 50]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Tota l</td></tr>
<tr><td>1 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>4</td><td>2</td><td>1</td><td>7</td></tr>
</table>

		II	4	2	2	**8**
		III	4	2	1	**7**
		Total no of questions	**12**	**6**	**4**	**22**
		Number of questions to be answered	**10**	**4**	**2**	**16**
		Total Marks	**10**	**20**	**20**	**50**

TEXT BOOKS:

1. Claster, William B. *Mathematics and programming for machine learning with R:from the ground up*. CRC Press, 2021.
2. Yoshida, Ruriko. *Linear algebra and its applications with R*. CRC Press, 2021.
3. Pfaff, Thomas J. *Applied Calculus with R*. Springer International Publishing, 2023.

SUGGESTED READINGS:

1. Zuur, Alain F., Elena N. Ieno, and Erik HWG Meesters. *A Beginner's Guide to R*.New York: Springer, 2009.
2. Matloff, Norman. *The art of R programming: A tour of statistical software design*. NoStarch Press, 2011.
3. Strang, Gilbert. *Introduction to linear algebra*. Wellesley-Cambridge Press, 2022.
4. Weir, Maurice D., et al. *Thomas' calculus: early transcendentals: based on theoriginal work by George B. Thomas, Jr*. Addison-Wesley, 2006.

ADVANCED READINGS:

1. Emmert-Streib, Frank S., Salissou Moutari and Matthias Dehmer. *MathematicalFoundations of Data Science using R*, De Gruyter, 2022.
2. Jones, Owen, Robert Maillardet and Andrew Robinson. *Introduction to ScientificProgramming and Simulation Using R*, 2nd edition, Chapman & Hall/CRC, 2014.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Any suitable topic from Textbook 2 can be included.

Semester 7

CourseCode	Title of the Course	Type of the Course	Credit	Hours/ Week
M24MT7DCC400	Advanced Linear Algebra-	Discipline Capstone Component (Advanced) - DCC	4	5
M24MT7DCC401	Theory Of ComplexFunctions	Discipline Capstone Component (Advanced) - DCC	4	4
M24MT7DCC402	Introduction to MetricSpaces	Discipline Capstone Component (Advanced) - DCC	4	4
M24MT7DCE400	Advanced Theory of Groups and Rings	Discipline Capstone Component (Advanced) - DCC	4	4
M24MT7DCE401	Real Analysis	Discipline Capstone Component (Advanced) - DCC	4	4
M24MT7DCE402	Graph Theory	Discipline Capstone Component (Advanced) - DCC	4	4

Discipline Capstone Component (Advanced) - DCCAdvanced Linear Algebra

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Advanced Linear Algebra</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Capstone Component (Advanced) – DCC</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT7DCC400</td></tr>
<tr><td>Course Level</td><td colspan="6">400</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course on linear algebra provides a comprehensive introduction to the fundamental concepts and techniques of linear algebra. The course covers a wide range of topics, including vector spaces, coordinates, linear transformations, linear functionals, matrix of linear transformations, dual spaces, characteristic values, annihilating polynomials, invariant subspaces, simultaneous triangulisation and diagonalisation, direct sum decomposition, and invariant direct sums.</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Basic definitions, properties and theorems on Fields, Vector spaces,subspaces, basis and dimension.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Analyse finite and infinite dimensional vector spaces and subspaces over a field and their properties including basis structure of vector spaces	An	1,2,3,6
2	Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism	A, An	1
3	Compute the characteristic polynomial, eigenvectors, eigenvalues and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result	A, E	1,2,3,4
4	Understand the basic theory of Simultaneous triangulations, Direct sum decompositions and Invariant direct sums	U, An	1
5	Utilize Python to perform computations efficientlyin linear algebra.	S, A	2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Review on Fields, Vector spaces, subspaces,basis and dimension (Theorems-Statements only)	1	**20**
	1.2	Coordinates	1, 2	
	1.3	Linear transformations and Algebra of LinearTransformations	1, 2	
	1.4	Isomorphism	1, 2	
		Problems (Practicum)	1,2	
	Text 1: Chapter 1 – Section: 1.1; Chapter 2 – Sections: 2.1 to 2.4;			

	Chapter 3 – Sections: 3.1 to 3.3.			
2	2.1	Representation of transformations by matrices	1, 2	**20**
	2.2	Linear functionals and dual space	1, 2	
	2.3	Double dual	1, 2	
		Problems (Practicum)	1,2	
	Text 1: Chapter 3 – Sections: 3.4 to 3.6			

3	3.1	Characteristic Values	3	**20**
	3.2	Diagonalizable linear operators	3,4	
	3.3	Annihilating polynomials	2,3,4	
	3.4	Cayley Hamilton Theorem	3,4	
	3.5	Invariant subspaces	3,4	
		Problems (Practicum)	2,3,4	
	Text 1: Chapter 6 – Sections: 6.1 to 6.4.			
4	4.1	Simultaneous triangulation; simultaneousdiagonalization	3,4	**15**
	4.2	Direct sum Decompositions	3,4	
	4.3	Invariant Direct Sums	3,4	
		Problems (Practicum)	3,4,5	
	Text 1: Chapter 6 – Sections: 6.5 to 6.7.			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem Solving Skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

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<tr><td colspan="6">Lectures, Tutorials, Interactive Sessions, Blended Learning</td></tr>
<tr><td rowspan="15">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
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<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Hoffman, K., Kunze, R. Linear algebra: Second edition. Prentice-Hall of India Pvt.Ltd, 1992.

SUGGESTED READINGS:

1. Strang, G.. *Linear algebra and its applications*. Cengage Learning, 2016.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. *Linear algebra and its applications* (5thed.). Pearson, 2023.
3. Lang, S. *Introduction to linear algebra (2nd ed.).* Springer-Verlag New York, Inc,1997.
4. Kumaresan, S. *Linear algebra: A geometrical appr*oach. Prentice-Hall of India,2000.
5. Axler, S. *Linear algebra done right* (4th ed.). Springer, 2023
6. Jänich, K. *Linear Algebra (Undergraduate Texts in Mathematics).* Springer-VerlagNew York, 2014.
7. Banchoff, T. F., & Wermer, J. T. *Linear algebra through geometry (2nd ed.).* Springer,2002.
8. Friedberg, S. H., Insel, A. J., & Spence, L. E. *Linear algebra (4th ed.).* Pearson, 2013.
9. Horn, R. A., & Johnson, C. R. *Matrix analysis (2nd ed.)*. Cambridge, UK: CambridgeUniversity Press, 2013.
10. Thamban Nair, M., & Singh, A. *Linear Algebra.* Springer, 2018.
11. Video lectures of Gilbert Strang Hosted by MITOpenCourseware available at VideoLectures | Linear Algebra | Mathematics | MIT Open Course Ware.
12. Klein, P. N. *Coding the Matrix Linear Algebra through Applications to ComputerScience*, Newtonian Press, 2013.
13. Dan Bader, David Amos, Joanna Jablonski, Fletcher Heister: *Python Basics: APractical Introduction to Python (1st Edition)* Real Python March 2021

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Use Python to perform computations in the modules 1 to 4 efficiently
- Transpose of a Linear Transformation (Chapter 3 Section 3.7)
- The rational and Jordan forms (Chapter 7-Sections 7.1 to 7.3)

Discipline Capstone Component (Advanced) - DCCTheory of Complex Functions

	**Mar Athanasius College (Autonomous), Kothamangalam** **FYUGP SYLLABUS**
Programme	**B Sc Mathematics**
Course Name	**Theory of Complex Functions**
Type of Course	**Discipline Capstone Component (Advanced) – DCC**
Course Code	**M24MT7DCC401**
Course Level	**400**
Course Summary	This course is designed to develop analytical skills in complex analysis and comprehensive understanding of topics in complex analysis, preparing students for further explorations. It will explore the properties of lines and half planes in the complex plane, investigate power series and their convergence, and uncover the geometric significance of spherical representations. The course will delve into the Mobius transformations, representation of complex analytic functions as power series, providing powerful tools for expanding and analyzing these functions. Cauchy's theorems, a cornerstone of complex analysis, will be studied in its various forms, revealing its profound implications for contour integration. Students will master the theory of complex integration, gaining proficiency in evaluating integrals along contours in the complex plane. The concept of the index of a closed curve, open mapping theorem and argument principle will be discussed and their implications being analyzed. These theorems provide deep insights into the behavior of analytic functions and their relationship with the complex plane.

Semester	7	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practicum	Others	Total Hours/week
		4	0	0	0	**4**

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Demonstrate a comprehensive understanding of the properties of lines and half planes in the complex plane, power series of complex numbers, spherical representation and Mobius transforms	U	1, 2, 3
2	Illustrate complex analytic functions as power series expansions, recognizing the convergence properties and regions of validity of these representations.	A	1, 3
3	Analyze various versions of Cauchy's theorem and applying them to solve complex integration problems.	An	1, 5
4	Evaluate the index of a closed curve and determine the types of residues (simple, pole, and essential singularities) that can occur within a given contour.	E	1, 2, 4
5	Interpret open mapping theorem and the argumentprinciple to gain insights into the behaviour of holomorphic functions and their mappings.	E	1, 2, 6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Lines and half planes in the complex plane	1	15
	1.2	Extended Plane and its Sphericalrepresentation	1	
	1.3	Power Series	1	
	1.4	Analytic functions	2	
	1.5	Analytic functions as mappings. MobiusTransformations	1	
	Text 1: Chapter 1 – Sections: 5 & 6; Chapter 3 – Sections: 1 to 3			
2	2.1	Riemann - Stieltjes integrals	3	15
	2.2	Power series representation of analyticfunctions	2	
	2.3	Zeros of an analytic function	2	
	2.4	The index of a closed curve	4	
	Text 1: Chapter 1 – Sections: 1 to 4 (only statements of theorem 1.4 and lemma 1.19)			
3	3.1	Cauchy's theorem and integral formula	3	15
	3.2	Homotopy version of Cauchy's theorem andsimple connectivity	3	
	3.3	Counting zeros, Open mapping theorem	5	
	3.4	Goursat theorem	3	
	Text 1: Chapter 4 – Sections: 5 to 8 (only statement of third version ofCauchy's theorem)			
4	4.1	Classification of singularities	4	15
	4.2	Residues	4	

	4.3	Argument Principle	5
	Text 1: Chapter 5 – Sections: 1 to 3		
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**		

Teaching andLearning Approach	**Classroom Procedure (Mode of transaction)**					
	Lecture methods Student Lectures on appropriate sections Activity based Tutorials/Practical Software based visualisation of concepts					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			**Mark Distribution**	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**				
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**

		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Conway, John B. *Functions of one complex variable, 2nd Edition.* Springer, 1978.

SUGGESTED READINGS:

3. Lars V. Ahlfors, *Complex Analysis, Third edition*, McGraw Hill Internationals, 1979
4. Gamelin, Theodore. *Complex analysis*. Springer Science & Business Media, 2003.
5. Priestley, H. A. *Introduction to Complex Analysis*. OUP Oxford, 2003.
6. Mathews, John, and Russell Howell. *Complex analysis for mathematics andengineering*. Jones & Bartlett Publishers, 2012.
7. Cartan, Henri. *Elementary theory of analytic functions of one or several complexvariables.* Courier Corporation, 1995.
8. Lang, Serge. *Complex analysis*. Vol. 103. Springer Science & Business Media, 2013.

ADVANCED READINGS:

1. Asmar, Nakhlé H., and Loukas Grafakos. *Complex analysis with applications*.Berlin: Springer, 2018.
2. Nevanlinna, Rolf, and Veikko Paatero. *Introduction to complex analysis*. Vol. 310.American Mathematical Society, 2007.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Study the Group structure of Mobius Transformations.
- Proof of Theorem 1.4 and Lemma 1.19 in Chapter 4 of Text 1
- Third version of Cauchy's Theorem
- Problems and applications of residues and Residue Theorem
- Discussion on latest research areas in Complex Analysis

Discipline Capstone Component (Advanced) - DCCIntroduction to Metric Spaces

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Introduction to Metric Spaces</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Capstone Component (Advanced) – DCC</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT7DCC402</td></tr>
<tr><td>Course Level</td><td colspan="6">400</td></tr>
<tr><td>Course Summary</td><td colspan="6">An introduction to fundamental concepts in Metric Space andgeneralization of continuity , connectedness, smallness conditions to metric spaces</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/Hours</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Set and Functions, Fundamentals of Analysis</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Visualize the concept of distance as a mathematicalfunction in various spaces	A, S, I, Ap	1,2,3,4,5
2	Develop their abstract thinking skills.	A, C, S, I, Ap	1,2,5,6

3	Define and Illustrate the concept of metric spaceand its properties	K, U,S,Ap	1,2,3,6
4	Explain the concept of continuity connectednessand compactness	K, U,S	1,2,3
5	Explain the fundamental concepts of modernanalysis and generalization to arbitrary sets.	K, A, C	1,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Inequalities	1	15
	1.2	Metric Spaces	1	
	1.3	Sequences in metric spaces	1,2	
	1.4	Cauchy Sequence (Definitions, Examples andstatements only)	2,3	
	1.5	Completion in Metric Spaces (Proof of Theorem 1.5.3 is excluded)	2,3	
	Text 1: Chapter 1 – Sections: 1.1 to 1.5			
2	2.1	Open and Closed Sets	3	15
	2.2	Relativization and subspaces	3,5	
	2.3	Countability Axioms and Separability	3,5	
	Text 1: Chapter 2 – Sections: 2.1 to 2.3			
	3.1	Continuous Mapping	**4**	15
	3.2	Uniform continuity	2 ,4	

3	3.3	Homeomorphism , Equivalent metrics andIsometry	2,4	
	Text 1: Chapter 3 – Sections: 3.1, 3.4 & 3.5			
4	4.1	Connectedness	4,5	**15**
	4.2	Bounded sets and compactness	4,5	
	4.3	Other characterisation of compactness	4,5	
	4.4	Continuous functions on compact spaces	4,5	
	Text 1: Chapter 4 – Sections: 4.1; Chapter 5 - Sections: 5.1 to 5.3			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**					
	Chalk and Talk, Group Discussion, Seminar, Interactive Sessions,Tutorials, Assignment, Quiz					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			**Mark Distribution**	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern **[Maximum Time 2 Hours, Maximum Marks 70]**				
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10**	

					Marks	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions tobe answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Satish Shirali, Harikrishnan L Vasudeva, Matric Spaces, Springer – Verlag LondonLimited 2006.

SUGGESTED READINGS:

1. Simmons, George F. *Introduction to Topology and Modern Analysis*,McGraw-Hill Book Company, 1963.
2. Joshi, K.D. *Introduction to General Topology*, Wiley Eastern Ltd, 1984.

ADVANCED READING:

1. Dugundji. Topology, Universal Book Stall, New Delhi, 1989.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Related Exercise problems in 1.6, 2.5, 3.8
- Proofs of all propositions in section 1.4
- Section 4.2: Local connectedness

Discipline Specific Elective – DSE

Advanced Theory of Groups and Rings

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Advanced Theory of Groups and Rings</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT7DCE400</td></tr>
<tr><td>Course Level</td><td colspan="6">400</td></tr>
<tr><td>Course Summary</td><td colspan="6">The objective of the course is to introduce advanced concepts in groups and rings. The first module includes direct products, classification of finitely generated abelian groups, factor groups and homomorphisms, normal subgroups and inner automorphisms. The second module covers computations of factor groups, simple groups, group actions and application of G-sets to finite groups. The third module includes isomorphism theorems, Sylow theorems and its applications. The fourth module contains homomorphism, factor rings
and concepts on ideals.</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Fundamentals of Groups and Rings</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand and construct direct products of groups and analyse the structure of finitely generated abelian groups	E	1,2,3,4,5,
2	Comprehend the concepts of normal subgroups, factor groups and simple groups, identify and apply the properties of factor groups and homomorphisms, compute factor groups and analyse their properties	A	1,2,3,6
3	Understand group action on a set, construct examples of G-sets and orbits and apply the resultson G-sets to the study of finite groups	An	1,2,3
4	Comprehending Sylow theorems, students will apply the Sylow theory to classify groups of different orders.	E	1,2
5	Analysing homomorphisms, factor rings, prime andmaximal ideals.	An	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Direct Products	1	**17**
	1.2	The structure of finitely Generated Abeliangroups	1	
	1.3	Applications	1	
	1.4	Factor groups	2	
	1.5	Homomorphisms and factor groups	2	

	1.6	Normal subgroups and inner automorphisms	2	
	Text 1: Sections: 9 & 12			
2	2.1	Factor group computations and Simplegroups	2	**17**
	2.2	Center and Commutator subgroups.Statement of Theorem 13.17.	2	
	2.3	Group action on a set: The notion of a groupaction	3	
	2.4	Isotropy subgroups, Orbits	3	
	2.5	Application of G-sets to finite groups	3	
	Text 1: Sections: 13 & 14			
3	3.1	Isomorphism theorems	2	**14**
	3.2	Sylow theorems	4	
	3.3	Applications of the Sylow theorems	4	
	Text 1: Sections: 16 & 17			
4	4.1	Factor rings	5	**12**
	4.2	Homomorphisms, Properties of	5	
	4.3	Fundamental homomorphism theorem (forrings)	5	
	4.4	Prime and maximal ideals	5	
	4.5	Prime Fields	5	
	Text 1: Sections: 30 & 31.1 to 31.20			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

<table>
<tr><td colspan="2">Teaching andLearning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="2"></td><td colspan="5">Lectures, Tutorials, Interactive Sessions, Blended Learning</td></tr>
<tr><td colspan="2" rowspan="4">Assessment Types</td><td colspan="5">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="4">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="3"></td><td colspan="3">Components</td><td>Mark Distribution</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td>15 Marks</td></tr>
<tr><td colspan="3">Seminar</td><td>10 Marks</td></tr>
<tr><td rowspan="11"></td><td></td><td colspan="3">Assignment</td><td>5 Marks</td></tr>
<tr><td>B</td><td colspan="4">Semester End Examination (Written)</td></tr>
<tr><td rowspan="10"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td>Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td><td></td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Fraleigh, John B., and Neal E. Brand. *A First Course in Abstract Algebra* 8th ed,Pearson Education, 2021

SUGGESTED READINGS:

1. Dummit, David S., and Richard M. Foote. *Abstract Algebra. 3rd ed.* Wiley, 2003.
2. Artin, M. *Algebra. 2nd ed., Pearson Education, 2017.*
3. Herstein, I. N. *Topics in Algebra*, 2nd *Edition, John Wiley and Sons, 2010*

4. Gallian , Joseph A, *Contemporary Abstract Algebra, 10th edition* ,Cengage 2015.
5. Musili , C. *Introduction to Rings and Modules*, 2nd revised Edition, Narosa ,1997.
6. Hungerford, Thomas W, *Algebra*, Springer,2011.

ADVANCED READINGS:

1. Hungerford, Thomas.W., Algebra, 4th Print 2003 Edition.
2. Lang, Serge, Algebra, 4th Print 2005 Edition

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Proving A_n is simple for $n \geq 5$.
- Applications of G-sets to counting. Burnside's Theorem (Section 15 of Text 1)

Discipline Specific Elective – DSE

Real Analysis

	**Mar Athanasius College (Autonomous), Kothamangalam** **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Real Analysis**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT7DCE401**					
Course Level	**400**					
Course Summary	This course covers essential topics in mathematical analysis, including functions of bounded variation and rectifiable curves, the Riemann- Stieltjes integral, sequence and series of functions. Students will explore the Riemann-Stieltjes integrals. Its applications to vector-valued functions will be addressed, along with discussions on uniform convergence, integration, and differentiation in the context of sequences and series of functions. The course concludes with an examination of equicontinuous families, the Weierstrass theorem, and the power series.					
Semester	**7**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		4	0	0	0	**4**
Pre- requisites, If any	Fundamentals of Mathematical Analysis					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Understand and analyses functions of bounded variations and its properties.	U, An	1
2	To analyze and parametrize curves, calculate arc lengths, and apply additive and continuity properties and fostering problem-solving skills in practical mathematical scenarios.	An	1,2,3
3	To understand and analyse the properties the Riemann-Stieltjes integral	U, An	1,5,6
4	To understand and analyse the concept of uniformconvergence and its properties.	U, An	1,4,5,6
5	To understand Equicontinuous families of functions	U	1,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Introduction, properties of monotonic functions,functions of bounded variation	1	15
	1.2	Total variation, additive property of total variation,total variation on (a, x) as a function of x.	1	
	1.3	Functions of bounded variation expressed as thedifference of increasing functions, continuous functions of bounded variation.	1	
	1.4	Curves and paths, rectifiable path and arc length	2	

	1.5	Additive and continuity properties of arc length.	2	
	Text 1: Chapter 6 - Sections: 6.1 to 6.11.			
2	2.1	Definition and existence of the integral	3	**15**
	2.2	Properties of the integral	3	
	2.3	Integration and differentiation.	3	
	2.4	Integration of vector valued functions.	3	
	Text 1: Chapter 6 - Sections: 6.12 to 6.25			
3	3.1	Sequence and series of functions - Discussion ofmain problem.	4	**15**
	3.2	Uniform convergence.	4	
	3.3	Uniform convergence and Continuity.	4	
	3.4	Uniform convergence and Integration.	4	
	3.5	Uniform convergence and Differentiation.	4	
	Text 2: Chapter 7 - Sections: 7.1 to 7.18.			
4	4.1	Equicontinuous families of functions.	5	**15**
	4.2	The Weierstrass theorem	5	
	4.3	Power series	5	
	Text 2: Chapter 7 - Sections: 7.19 to 7.27; Chapter 8 – sections: 8.1 to 8.5.			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching and	**Classroom Procedure (Mode of transaction)**

<table>
<tr><td>Learning Approach</td><td colspan="6">Lecture, Tutorial and Activity oriented</td></tr>
<tr><td></td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td rowspan="11">Assessment Types</td><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Seminar</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="8"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOKS:

1. Apostol, Tom M. *Mathematical analysis*. Narosa, 1974.
2. Rudin, Walter. *Principles of mathematical analysis*. Vol. 3. New York: McGraw-hill,1976.
3.

SUGGESTED READINGS:

1. Stein, Elias M., and Rami Shakarchi. *Real analysis: measure theory, integration, andHilbert spaces*. Princeton University Press, 2009.

2. Abbott, Stephen. *Understanding analysis.*.springer publication, 2015.
3. Fitzpatrick, Patrick. *Advanced calculus*.Vol. 5. American Mathematical Soc., 2009.
4. Folland, Gerald B. *Real analysis: modern techniques and their applications*. Vol. 40.John Wiley & Sons, 1999.
5. Royden, H.L. *Real Analysis, 2nd edition*, Macmillan, New York.

ADVANCED READINGS:

1. Gelbaum, Bernard R., and John MH Olmsted. *Counterexamples in analysis*. CourierCorporation, 2003.
2. Carothers, Neal L. *Real analysis*. Cambridge University Press, 2000.
3. Rudin, Walter. Real and complex analysis, Mcgraw-hill international editions:Mathematics series, 1987.
4. Axler, Sheldon. *Measure, integration & real analysis*. Springer Nature, 2020.
5. Widder, David V. *Advanced calculus*. Courier Corporation, 2012.
6. Franklin, Philip. *A treatise on advanced calculus*. Courier Dover Publications, 2016.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Equivalence of paths, change of parameter. (*Text 1, Chapter 6 Section 6.12*)
- Linear Space of functions.
- Absolutely continuous functions and Bounded variation.
- Uniform Lipschitz condition and bounded variation.
- Prime numbers and Riemann zeta function.
- Riemann Stieljes integration of Cantor sets
- Weak form of Lebesgue's dominated convergence theorem.
- Helly's Selection Theorem.
- Space Filling Curves.
- The algebraic completeness of complex field.
- The exponential and logarithmic functions.
- The trigonometric functions.
- Algebra and its Uniform closure
- Stone's generalization of the Weierstrass theorem (Theorem)
- Fourier series.
- Gamma Functions.

Discipline Specific Elective – DSE

Graph Theory

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Graph Theory</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT7DCE402</td></tr>
<tr><td>Course Level</td><td colspan="6">400</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course provides a comprehensive introduction to graph theory, equipping students with the knowledge and skills to analyse and solve problems in diverse fields like computer science, biology, chemistry, sociology, operations research etc.</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="2">Credits</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Fundamentals of Sets and Relations</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		

1	Understand basic concepts and properties of graphs.	U	1,2,5,6
2	Analyse real world problems using graph theory	An	1,2,3,4
3	Understand the theoretical approach of graph theory	U	1,2,3,4,5
4	Identify research problems relating to graph theory	I	1,2,3,4,5
5	Visualize graphs using different software.	S	1,2,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill(S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Introduction, Basic concepts, Subgraphs, Degrees of vertices.	1	**15**
	1.2	Paths and Connectedness.	3	
	1.3	Operations on graphs.	3	
	1.4	Directed Graphs: Introduction, basic concepts.	3	
	1.5	Tournaments.	3	
	Text 1: Chapter 1 – Sections: 1.1 to 1.5, 1.8; Chapter 2 – Sections: 2.1 to 2.3			
2	2.1	Connectivity: Introduction, Vertex cutsand edge cuts	1, 3	**15**
	2.2	Connectivity and edge connectivity.	3	
	2.3	Blocks.	1	
	Text 1: Chapter 1 – Sections: 3.1 to 3.3, 3.4.1 & 3.4.2			
	3.1	Trees: Introduction, Definition,characterization and simple properties.	1, 3	

3	3.2	Centres and Centroids.	1, 3	**15**
	3.3	Independent Sets.	1, 2	
	3.4	Eulerian and Hamiltonian Graphs:Introduction, Eulerian graphs.	1, 2, 3	
	3.5	Hamiltonian Graphs, Closure of graphs.	1, 2, 3	
	Text 1: Chapter 4 – Sections: 4.1 to 4.3; Chapter 5 – Sections: 5.1, 5.2; Chapter 6 – sections: 6.1 to 6.3			
4	4.1	Graph Colorings: Introduction, VertexColoring.	1, 2, 3, 4	**15**
	4.2	Planarity: Introduction, Planar andNonplanar Graphs.	1, 2, 3	
	4.3	Euler Formula and its consequences, K_5 and $K_{3,3}$ are Non-planar Graphs.	2, 3	
	Text 1: Chapter 7 – Sections: 7.1 to 7.2.5; Chapter 8 – Sections: 8.1 to 8.4			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**		
	Direct Instruction, Brain Storming Approach, Interactive instruction, Group Discussion, Presentation by individual student/ group representatives.		
	MODE OF ASSESSMENT		
	A	**Continuous Comprehensive Assessment (CCA)**	
		Components	**Mark Distribution**
		Teacher Specific Content	20 Marks
		Quiz in any mode	5 Marks
		Assignment	5 Marks

Assessment Types	B	Semester End Examination (Written)			
		Question Pattern [Maximum Time 2 Hours, Maximum Marks 70]			
		Module	Part A	Part B	Part C	Total
			2 Marks	**5 Marks**	**10 Marks**	
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Balakrishnan, R., and Ranganathan, K. A *Textbook of Graph Theory*. Secondedition, Germany Springer New York, 2012.

SUGGESTED READINGS:

1. Chartrand, Gary, and Zhang, Ping. *Chromatic Graph Theory*. United States, CRCPress, 2019.
2. Clark, John, and Derek Allan Holton. *A First Look at Graph Theory*. World ScientificPublishing Company, 1991.
3. Rosen, Kenneth H. *Discrete Mathematics and Its Applications*. UnitedStates, McGraw-Hill Higher Education -, 2016.
4. West, Douglas Brent. *Introduction to Graph Theory*. United Kingdom, Pearson, 2018.
5. Wilson, Robin J. *Introduction to Graph Theory* UPDF EBook. UnitedKingdom, Pearson Education, 2015.

ADVANCED READINGS:

1. Bondy, John Adrian, and Murty, U. S. R. *Graph Theory with Applications*. UnitedKingdom, Macmillan, 1976.
2. Hsu, Lih-Hsing, and Lin, Cheng-Kuan. *Graph Theory and InterconnectionNetworks*. United States, CRC Press, 2008.
3. Haynes, Teresa W., et al. *Fundamentals of Domination in*

*Graph*s. UnitedStates, CRC Press, 2013.
4. Biggs, Norman. *Algebraic Graph Theory*. United Kingdom, Cambridge UniversityPress, 1993.
5. Kottarathil, Jomon, et al. *Graph Theory and Decomposition*. CRC Press, Boca Raton,USA, 2024.
6. Li, Xueliang, et al. *Graph Energy. United States*, Springer New York, 2012.
7. Bapat, Ravindra B. *Graphs and Matrices.* India, Springer London, 2014.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- An application to Chemistry(Section 1.10),
- An application to Social Psychology (Section 1.11),
- Proof of theorem 2.3.2

- Counting the number of Spanning Trees (Section 4.4),
- Cayley's Formula (Section 4.5),
- Applications: The Connector Problem (Section 4.7.1),
- Kruskal's Algorithm
- Edge Coloring (Section 7.6)
- The Four-Color Theorem and the Heawood Five-Color Theorem (Section 8.6)
- Spectral Properties of Graphs: Chapter 11
- Visualize graphs using software like Sage Math, Python, or Wolfram Mathematica

Semester 8

CourseCode	Title of the Course	Type of the Course	Credit	Hours/ Week
M24MT8DCC400	Functional Analysis	Discipline Capstone Component(Advanced) - DCC	4	5
M24MT8DCC401	Measure Theory andIntegration	Discipline Capstone Component(Advanced) - DCC	4	5
M24MT8DCE400	Basic Topology	Discipline Capstone Component(Advanced) - DCC	4	5
M24MT8DCE401	Field Theory	Discipline Capstone Component(Advanced) - DCC	4	5
M24MT8DCE402	Optimization Techniques	Discipline Capstone Component(Advanced) - DCC	4	5

Discipline Capstone Component (Advanced) - DCCFunctional Analysis

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Functional Analysis</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Capstone Component (Advanced) – DCC</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT8DCC400</td></tr>
<tr><td>Course Level</td><td colspan="6">400</td></tr>
<tr><td>Course Summary</td><td colspan="6">This is a comprehensive curriculum on vector spaces and related concepts which facilitate between Linear Algebra and Advanced Functional Analysis. It covers various aspects of normed spaces, linear operators, inner product spaces and Hilbert spaces. These chapters delve into the properties of vector spaces equipped with different structures, like norms and inner products. The concepts progress from normed spaces, linear operators and functionals to more specialized spaces like Hilbert spaces, emphasizing their properties, relationships and specific identities related to inner product spaces. The course ends with Hahn- Banach Theorem, the most important theorem connected with bounded linear operators, which is an extension theorem for linear functionals and guarantees that a normed space is richly supplied with linear functionals. The concepts and problems are intended to help the student to develop skill and intuition in Functional Analysis and its applications.</td></tr>
<tr><td>Semester</td><td>8</td><td colspan="3">Credits</td><td colspan="2">5</td></tr>
<tr><td rowspan="2">Course Details</td><td>Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td></td><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="6">Ordinary Calculus, Metric spaces, Cauchy sequences, Complete spaces,Linear Algebra of finite dimensional vector spaces.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Analyse the additional characteristics and properties exhibited by normed spaces and comprehend how these properties influence the behaviour of elements within these spaces.	An	1,2,3,4
2	Analyse the behaviour and properties of linear operators and functionals in various spaces.	An	1,2,3,6
3	Evaluate the structure and properties of Inner product spaces and Hilbert spaces, emphasizing completeness and orthogonality.	E	1,2,3,4,5,6
4	Understand the concept of the orthogonal complements and direct sum in relation to Inner Product spaces. Analyse the representation of functionals on HibertSpaces and Hilbert Adjoint Operators	U, An	1,2,3,4
5	Understand Hahn - Banach Theorem, the most important theorem in connection with bounded linear operators and its generalisation to Complex Vector spaces and normed spaces.	U	1,2,3,4,5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Vector space	1	20
	1.2	Normed spaces, Banach spaces	1	
	1.3	Further properties of normed spaces. (Proofof Completion theorem (2.3-2) excluded)	1	
	1.4	Finite dimensional normed spaces andsubspaces	1	
	1.5	Compactness and finite dimension.	1	
		Problems of all sections (Practicum)	1	
	Text 1: Chapter 2 - Sections: 2.1 to 2.5			
2	2.1	Linear operators.	2	18
	2.2	Bounded and continuous linear operators.	1, 2	
	2.3	Linear functionals (Algebraic dual, second algebraic dual and algebraic reflexivity areexcluded)	2	
	2.4	Linear operators and functionals on finite dimensional spaces (Proof of theorem 2.9-3excluded)	2	
	2.5	Normed space of operators, Dual spaces.	2	
		Problems of all Sections (Practicum)	1, 2	
	Text 1: Chapter 2 - sections: 2.6, 2.7, 2.8.1 to 2.8.8, 2.9 & 2.10			
3	3.1	Inner product spaces, Hilbert spaces.	3	20
	3.2	Further properties of inner product spaces.(Proof of Completion theorem (3.2-3) excluded)	3	
	3.3	Orthogonal complements	4	

		3.4	Direct sums	4	
		3.5	Orthonormal sets and sequences	4, 5	
		3.6	Series related to orthonormal sequences andsets (Example 3.5-1 excluded)	4,5	
		3.7	Total orthonormal sets and sequences(Proof of theorem 3.6-5 excluded)	4,5	
			Problems of 3.1, 3.2 & 3.3 (Practicum)	3, 4, 5	
		Text 1: Chapter 3 - Sections: 3.1 to 3.6			
4	4.1	Representation of Functionals on HilbertSpaces. (Proof of Riesz representation theorem (3.8-4) excluded)	4	**17**	
	4.2	Hilbert-adjoint operator.	4		
	4.3	Self-Adjoint, Unitary and NormalOperators.	5		
	4.4	Zorn's lemma.	5		
	4.5	Hahn-Banach Theorem.	5		
	4.6	Hahn-Banach Theorem for Complex VectorSpaces and Normed Spaces	5		
		Practicum (Problems)	**4, 5**		
	Text 1: Chapter 3 - Sections: 3.8 to 3.10; Chapter 4 - Sections: 4.1 to 4.3				
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**				

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
It's purpose is to encourage creativity and to develop Problem solving skills.
The practicum component is to be done in the classroom under the strict guidance of the teachers.
A minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching andLearning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture methods, Problem Solving Methodologies, Activity BasedTutorials/ Practical, Software Based Visualisation of Concepts</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="9"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Erwin Kreyszig, *Introductory Functional Analysis with Applications*, WileyInternational publication. 1978 (Reprint 2007)

SUGGESTED READINGS:

1. Limaye, B V. *Functional Analysis*. New Age International (P) LTD, New Delhi,2004.
2. Simmons, G F. *Introduction to Topology and Modern Analysis*, Mc Graw-Hill, NewYork,1963.
3. Siddiqi, A H. *Functional Analysis with Applications*, Tata Mc Graw-Hill, New Delhi,1989.
4. Walter Rudin. *Functional Analysis, Second Edition*, International Series in Pure &Applied Mathematics, Tata Mc Graw Hill, 1973.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Example 2.2-7
- Proof of completion theorem 2.3-2
- Canonical mapping and algebraic reflexivity (2.8)
- Example 3.1-5
- Proof of Completion theorem 3.2-3
- Example 3.5.1
- Proof of theorem 3.6-5
- Legendre, Hermite and Laguerre Polynomials (3.7)
- Proof of Riesz representation theorem 3.8-4
- Application to Bounded Linear Functionals on C[a,b] (4.4)

Discipline Capstone Component (Advanced) – DCC

Measure Theory and Integration

	**Mar Athanasius College (Autonomous), Kothamangalam** **FYUGP SYLLABUS**
Programme	**B Sc Mathematics**
Course Name	**Measure Theory and Integration**
Type of Course	**Discipline Capstone Component (Advanced) – DCC**
Course Code	**M24MT8DCC401**
Course Level	**400**
Course Summary	This course provides a comprehensive exploration of measure theory and integration, with a primary focus on the development and applications of the Lebesgue measure and integral. The syllabus covers fundamental concepts such as Lebesgue outer measure, sigma algebra of Lebesgue measurable sets, outer and inner approximation techniques, countable additivity, and the Borel-Cantelli Lemma. Students will delve into non-measurable sets, including the Canter set and Canter Lebesgue function. The second part of the course introduces Lebesgue measurable functions and their integration. Topics include Lebesgue integration for sums, products, and compositions of functions, sequential pointwise limits, and simple approximations. Classical theorems, including Littlewood's three principles, Egoroff's theorem, and Lusin's theorem, are presented without proof to provide a practical understanding of theirapplications. The Lebesgue integration section covers a comparison between the Riemann and Lebesgue integrals. Students will learn to calculate the Lebesgue integral of bounded measurable functions over sets of finite measure, as well as explore the integral for measurable non-negative

	functions. The General Lebesgue Integral is introduced along with discussions on countable additivity and continuity of integration. The course also addresses the integration of derivatives and the differentiation of indefinite integrals.					
	The latter part of the course extends the study to general measure spaces. Students will explore properties and constructions of measures and measurable sets. Signed measures, Hahn and Jordan decompositions, and the Caratheodory Measure induced by an outer measure are discussed. The construction of outer measures is covered, leading to advanced theorems such as the Radon-Nikodym Theorem, Lebesgue Decomposition Theorem, and Radon-Nikodym Derivative. The course concludes with a generalization of measurability concepts for functions on general measurable spaces. Students will study integration over general measure spaces, utilizing the Caratheodory construction of measure. The construction of product measures is introduced, and classic theorems of Fubini and Tonelli are proven. By the end of the course, students will have a comprehensive understanding of measure theory and integration, with the ability to apply these concepts in both Lebesgue and general measure spaces. The course aims to equip students with the analytical tools necessary for advanced mathematical applications and research.					
Semester	**8**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre-requisites, If any	Fundamentals of Mathematical Analysis					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, the studentwill be able to		
1	Acquire a deep understanding of the principles behind the Lebesgue measure, including its introduction, outer measure, and the sigma algebra associated with Lebesgue measurable sets	U	1
2	Master the principles of countable additivity and continuity, fundamental for Lebesgue measure theory through theoretical understanding and practical applications,	A	1,2,3
3	Recognize and analyze non-measurable sets, including specific examples like the Cantor set, and comprehend theimplications of their existence	E	1
4	Develop proficiency in integrating functions within the Lebesgue framework, including the Riemann integral, Lebesgue integral of bounded and non-negative measurable functions, and the General Lebesgue Integral.	C	1,2,6
5	Proficient in utilizing the Caratheodory construction of measure, allowing them to construct product measures and prove classic theorems such as Fubini and Tonelli in the context of general measure spaces.	U, S	1,5,6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1		**Lebesgue Measure**		**20**
	1.1	Introduction	1	
	1.2	Lebesgue outer measure	1	
	1.3	The □ algebra of Lebesgue measurable sets	1	

	1.4	Outer and inner approximation of Lebesguemeasurable sets	1	
	1.5	Countable additivity, continuity and Borel-Cantelli Lemma	1, 2	
		Practicum (Problems)		
	Text 1: Chapter 2 - Sections: 2.1 to 2.5			
2		**Measurable Functions**		
	2.1	Non measurable set	2, 3	
	2.2	The Cantor set and Cantor Lebesgue function	2, 3	
	2.3	Lebesgue Measurable Functions: Sums,products and compositions	3	**17**
	2.4	Sequential pointwise limits and simpleapproximation	3	
	2.5	Littlewood's three principles, Egoroff's theorem, and Lusin's theorem (All theorems without proof)	3	
		Problems (Practicum)	2,3	
	Text 1: Chapter 2 - Sections: 2.6 to 2.7, 3.1 to 3.3			
3		**Lebesgue Integration**		
	3.1	The Riemann Integral	4	
	3.2	The Lebesgue integral of a bounded measurable function over a set of finitemeasure	4	
	3.3	The Lebesgue integral of a measurable non negative function	4	**20**
	3 .4	The General Lebesgue Integral.	4	
	3.5	Countable Additivity and Continuity ofIntegration	4	
	3.6	Integrating Derivatives: DifferentiatingIndefinite Integrals	4	
		Problems (Practicum)	4	
	Text 1: Chapter 2 - Sections: 4.1 to 4.5; Chapter 6 - Section: 6.5			

4		**General Measure spaces: Their properties and construction**		
	4.1	Measures and Measurable Sets (Theorems without proof)	**5**	**18**
	4.2	Signed Measures: The Hahn and Jordan Decompositions	**5**	
	4.3	The Caratheodory Measure Induced by an Outer Measure (Propositions 5,6 and 7 Statement only)	**5**	
	4.4	The Construction of Outer Measures	**5**	
	4.5	The Radon-Nikodym Theorem (without proof), The Lebesgue Decomposition Theorem and Radon-Nikodym Derivative	**5**	
		Problems (Practicum)	**5**	
	Text 2: Chapter 17 - Sections: 17.1 to 17.4; Chapter 18 - Section: 18.4			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. as specified by the teacher concerned)* **This content will be evaluated internally**			

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
It's purpose is to encourage creativity and develop Problem Solving Skills.
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<tr><td rowspan="13">Teaching andLearning Approach</td><td colspan="6">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="6">Lecture and Tutorial</td></tr>
<tr><td colspan="6">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="5">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="3">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="3">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="3">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="3">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
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<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
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<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. Royden, H. L. , Fitzpatrick, P.M. *Real Analysis Fourth Edition, PearsonEducation, 2010.*

SUGGESTED READINGS:

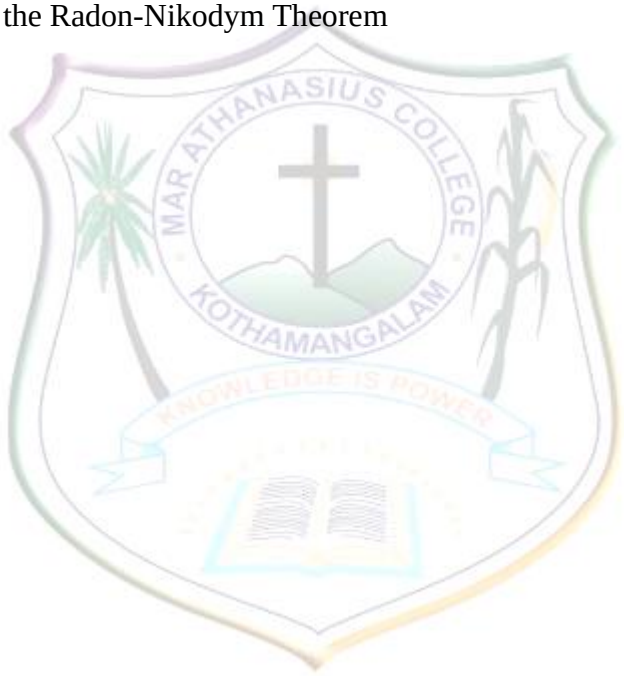
1. Barra, G. de. *Measure Theory and integration*, New Age International (P) Ltd., NewDelhi, 1981 (Reprint 2003)
2. Halmos, P.R. *Measure Theory*, D. van Nostrand Co., 1974

3. Jain, P.K., and Gupta,V.P. *Lebesgue Measure and Integration*, New Age International

   (P) Ltd., New Delhi, 1986 (Reprint 2000).
4. Bartle, R.G.,*The Elements of Integration*, John Wiley & Sons, Inc New York, 1966.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Generalize the concepts of measurability of functions on general measurable spaces.
- Study the integration over general measure spaces
- Using Caratheodory construction of measure, construct product measures and provethe classic theorems of Fubini and Tonelli
- Prove the Radon-Nikodym Theorem



Discipline Specific Elective – DSE

Basic Topology

<table>
<tr><td>  </td><td colspan="6">Mar Athanasius College (Autonomous), Kothamangalam
FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="6">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="6">Basic Topology</td></tr>
<tr><td>Type of Course</td><td colspan="6">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">M24MT8DCE400</td></tr>
<tr><td>Course Level</td><td colspan="6">400</td></tr>
<tr><td>Course Summary</td><td colspan="6">Course introduces properties of topological spaces, includingCompactness, Connectedness and Separation axioms</td></tr>
<tr><td>Semester</td><td>8</td><td colspan="3">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre-requisites,If any</td><td colspan="6">Fundamentals of Analysis and Basics of Metric spaces.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Define and illustrate the concept of subspace andclosed sets of a topological space	K, U, S, Ap	1, 2, 3, 5

2	Describe the concept of neighbourhoods andinterior point of a point in a topological space	U, I, Ap	1, 2, 3, 4
3	Prove a selection of theorems concerning topological spaces, continuous functions, and quotient topologies.	U, An, Ap	1,2, 4
4	Define and illustrate the concepts of compact andLindeloff Space and their properties	K, U, S, An, S, I, Ap	1,2,4
5	Define connectedness, separation axioms, andprove related theorems	K, U, S, An, S, I, Ap	2,3, 4, 6
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Definition and related concepts. Examples of topological spaces (Practicum)	1	**20**
	1.2	Bases and subbases	1	
	1.3	Subspaces	1	
	1.4	Closed Sets and Closure	1	
		Problems (Practicum)	1	
	Text 1: Chapter 4 – Sections: 1, 2, 3 (3.1 to 3.9), 4; Chapter 5 – Section: 1			
2	2.1	Neighbourhoods, Interior and Accumulation points	2	**20**
	2.2	Continuity. Related concepts (Practicum)	3	
		Problems (Practicum)	2,3	
	Text 1: Chapter 5 – Sections: 2 (2.1 to 2.10 and 2.13) & 3 (3.1 to 3.10)			
3	3.1	Making functions continuous and Quotient Spaces	3	**15**
	3.2	Smallness condition on a Space	4	

		Problems (Practicum)	3,4	
	Text 1: Chapter 5 – Sections: 4 (4.1 to 4.12); Chapter 6 – Section 1(1.1 to 1.11)			
4	4.1	Connectedness	5	**20**
	4.2	Path Connectedness (Practicum)	5	
	4.3	Separation axioms	5	
		Practicum (Problems)	5	
	Text 1: Chapter 6 – Sections: 2 & 3 (3.6 to 3.8); Chapter 7 – Section: 1			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**ts purpose is to encourage creativity and develop problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="5">Chalk and talk, Group discussion, Seminar, Interactive sessions, Tutorials,Assignment, Quiz</td></tr>
<tr><td rowspan="6">Assessment Types</td><td colspan="5">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="4">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="2">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="2">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="2">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="2">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td rowspan="11"></td><td>B</td><td colspan="5">Semester End Examination (Written)</td></tr>
<tr><td rowspan="10"></td><td colspan="5">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>Total no of questions</td><td>12</td><td>9</td><td>4</td><td>25</td></tr>
<tr><td>Number of questions to be answered</td><td>10</td><td>6</td><td>2</td><td>18</td></tr>
<tr><td>Total Marks</td><td>20</td><td>30</td><td>20</td><td>70</td></tr>
</table>

TEXT BOOK:

1. K. D. Joshi. *Introduction to General Topology*, Third Edition, New AgeInternational(P) Ltd, 2023.

SUGGESTED READINGS:

1. Munkres J.R, *Topology-A First Course*, Prentice Hall of India (P). Ltd., New Delhi,2000.
2. Willard, Stephen. *General Topology*, Addison-Wesley, 2004.
3. George F Simmons, *Introduction to Topology and Modern Analysis*, McGraw-HillBook Company, 1963.

ADVANCED READINGS:

1. Dugundji. *Topology*, Universal Book Stall, New Delhi, 1989.
2. J. Arthur Seebach, Lynn Arthur Steen, *Counter Examples in Topology*, DoverPublications, 1995

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Study the concept of nearness relation on a set and the one-to-one correspondencebetween set of topologies on a set and the set of nearness relation on that set.
- Study the concept of embedding problem, extension problem and lifting problem.
- Study the concept of identification space and identification maps.
- Study the concept of local connectedness.

Discipline Specific Elective – DSE

Field Theory

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Mathematics**					
Course Name	**Field Theory**					
Type of Course	**Discipline Specific Elective – DSE**					
Course Code	**M24MT8DCE401**					
Course Level	**400**					
Course Summary	The objective of the course is to learn more about field theory. The first module covers topics on ring of polynomials, factorization of polynomials etc. The second module covers concepts on extension fields, finite fields etc. The third module includes automorphisms of fields, splitting fields etc. Topics on separable extensions, Galois theoryetc. are covered in the fourth module.					
Semester	**8**	**Credits**			**4**	
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	Total Hours/week
		3	0	2	0	**5**
Pre- requisites, If any	Concepts from Fundamentals of Groups and Rings and Advanced Theoryof Groups and Rings					

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, thestudent will be able to		
1	Explain ring of polynomials, master polynomial factorization, and comprehend the ideal structure in F[x].	An	1,2,3,4,5,6
2	Comprehend the concept of extension, distinguish the various types of extensions and analyse finite fields.	An	1,5,6
3	Examine field automorphisms, categorize splitting fields and apply the isomorphism extension theorem.	A	1,2,3,6
4	Analyse separable extensions and understand the Galois theorems.	E	1
5	Analyse constructible numbers and understand theconcepts of UFD, PID and Euclidean Domains	An	2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO No:	Hours
1	1.1	Rings of polynomials, The evaluationhomomorphisms	1	15
	1.2	Factorization of polynomials over a field, Thedivision algorithm in F[x]	1	
	1.3	Irreducible polynomials, Uniqueness offactorization in F[x]	1	
	1.4	Ideal Structure in $F[x]$, Application to uniquefactorization in F[x]	1	
		Practicum (Problems)		
	Text 1: Sections: 27, 28 & 31 (31.21 to 31.27)			

2	2.1	Introduction to Extension fields, Algebraic andtranscendental elements, The irreducible polynomial for α over F	2	**20**
	2.2	Simple extensions	2	
	2.3	Algebraic extensions, Algebraically closed fieldsand algebraic closures	2	
	2.4	Finite fields, The existence of $GF(p^n)$	2	
		Practicum (Problems)		
	Text 1: Sections: 39, 40 (40.1 to 40.18) & 42			
3	3.1	Introduction to Galois theory	3	**20**
	3.2	Conjugation isomorphism	3	
	3.3	Splitting fields, The isomorphism extension theorem	3	
	3.4	Properties of splitting fields	3	
		Practicum (Problems)		
	Text 1: Sections: 43, 44 (44.1 to 44.4, 44.5 (Statement only) & 44.6 to 44.15)			
4	4.1	Separable extensions, Characteristic p	4	**20**
	4.2	Counting Automorphisms, The primitiveelement theorem	**4**	
	4.3	Normal extensions	4	
	4.4	Galois Theory, The Galois theorems	4	
		Practicum (Problems)		
	Text 1: Sections 45 & 46			
5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**			

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. **I**t's purpose is to encourage creativity and develop Problem solving skills. **T**he practicum component is to be done in the classroom under the strict guidance of the teachers. **A** minimum of 30 problems is to be solved, and a handwritten copy of the solutions should be kept in the department.

<table>
<tr><td rowspan="2">Teaching andLearning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)</td></tr>
<tr><td colspan="5">Direct Instruction: Explicit Teaching, Lecture

Interactive Instruction: Active Co-operative Learning, SeminarPresentation by Individual Student</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="5">MODE OF ASSESSMENT</td></tr>
<tr><td>A</td><td colspan="4">Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="4"></td><td colspan="2">Components</td><td colspan="2">Mark Distribution</td></tr>
<tr><td colspan="2">Teacher Specific Content</td><td colspan="2">20 Marks</td></tr>
<tr><td colspan="2">Quiz in any mode</td><td colspan="2">5 Marks</td></tr>
<tr><td colspan="2">Assignment</td><td colspan="2">5 Marks</td></tr>
<tr><td>B</td><td colspan="4">Semester End Examination (Written)</td></tr>
<tr><td rowspan="6"></td><td colspan="4">Question Pattern
[Maximum Time 2 Hours, Maximum Marks 70]</td></tr>
<tr><td rowspan="2">Module</td><td>Part A</td><td>Part B</td><td>Part C</td><td rowspan="2">Total</td></tr>
<tr><td>2 Marks</td><td>5 Marks</td><td>10 Marks</td></tr>
<tr><td>I</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>II</td><td>3</td><td>3</td><td>1</td><td>7</td></tr>
<tr><td>III</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
<tr><td>IV</td><td>3</td><td>2</td><td>1</td><td>6</td></tr>
</table>

		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to be answered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOK:

1. Fraleigh, John B., and Neal E. Brand. *A First Course in Abstract Algebra* 8th ed,Pearson Education, 2021.

SUGGESTED READINGS:

1. Dummit, David S., and Richard M. Foote. *Abstract Algebra. 3rd ed.* Wiley, 2003.
2. Artin, M. *Algebra. 2nd ed., Pearson Education, 2017*
3. Herstein, I. N. *Topics in Algebra*, 2nd *Edition.,John Wiley and Sons, 2010*
4. Gallian , Joseph A, *Contemporary Abstract Algebra*, *10th edition* ,Cengage 2021.
5. Musili , C. *Introduction to Rings and Modules*, 2nd revised Edition, Narosa, 1997.

ADVANCED READINGS:

1. Hungerford, Thomas.W., Algebra, 4th Print 2003 Edition.
2. Lang, Serge, Algebra, 4th Print 2005 Edition

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Unique Factorization Domains, Euclidean Domains ; Understanding the concepts of Unique Factorization Domain, Principal Ideal Domain, Euclidean Domain and analysing the relationships among the three.

  (Text 1: Sections 34, 35)
- Geometric Constructions ; Gaining a basic knowledge of constructible numbers and illustrates the impossibility of certain constructions (Doubling the cube, squaring the circle, trisecting the angle) (Text 1: Sections 41)

Discipline Specific Elective – DSE

Optimization Techniques

<table>
<tr><td>  </td><td colspan="5">Mar Athanasius College (Autonomous),
Kothamangalam

FYUGP SYLLABUS</td></tr>
<tr><td>Programme</td><td colspan="5">B Sc Mathematics</td></tr>
<tr><td>Course Name</td><td colspan="5">Optimization Techniques</td></tr>
<tr><td>Type of Course</td><td colspan="5">Discipline Specific Elective – DSE</td></tr>
<tr><td>Course Code</td><td colspan="5">M24MT8DCE402</td></tr>
<tr><td>Course Level</td><td colspan="5">400</td></tr>
<tr><td>Course Summary</td><td colspan="5">This Mathematics undergraduate course investigates linear programming methods, including simplex techniques and duality theorems. It explores challenges related to Integer Linear Programming (ILP) and Mixed Integer Linear Programming (MILP), utilizing cutting-edge approaches like cutting planes and branch-and-bound methods. The curriculum also includes fundamental concepts in graph theory, such as minimum path and spanning trees, as well as sequential activity scheduling and maximum flow problems. Furthermore, the course provides an introduction to Unconstrained Optimization, utilizing tools like Taylor's series, Fibonacci, and Golden Section searches. Constrained Optimization is also covered, incorporating topics such as gradient projection and Lagrange multipliers.</td></tr>
<tr><td>Semester</td><td>8</td><td colspan="2">Credits</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practicum</td><td>Others</td><td>Total Hours/week</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Pre- requisites, If any</td><td colspan="5">Linear Programming Problem, Formation of an LPP. Optimal solution</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No:	Expected Course Outcome	Learning Domains	PSO No:
	Upon the successful completion of the course, the studentwill be able to		
1	Apply graphical method to solve LP problems, mastering simplex tableau and duality principles for solving LP problems.	A	1, 2
2	Students master ILP, MILP problems, cutting plane, and Branch-and-Bound methods, enhancing problem-solving and optimization skills	An	1, 2
3	Analyze graphs, solve minimum path and spanning tree problems, and optimize sequential activities with maximum flow.	An	1, 2
4	Find the solution of unconstrained optimization problems using Taylor's series, Fibonacci, Golden Section, and Hooke-Jeeves methods.	E	1,2, 3
5	Find the solution of constrained optimization problems using gradient projection, Lagrange multipliers, and constrained derivatives techniques.	E	1, 2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	CO NO:	Hours
1		**Linear Programming**		**20**
	1.1	LP in two-dimensional space and problems, Statement of General LP problems, Definitions of FS, BS, BFS and OS, Simplex tableau and problems.	1	
	1.2	Definition of Artificial Variable and Big-M Method,Meaning of Degeneracy in LP Problems	1	
	1.3	Duality in LP Problems, Duality Theorems (statementsonly), Dual Simplex Method	1	
		Problems (Practicum)	1	
	Text 1: Chapter 3 – Sections: 3.2, 3.3, Definitions in Sections 3.4 to 3.7, 3.12 to 3.14, 3.17, 3.18 & 3.20			

2		**Integer Programming**		**15**
	2.1	General ILP and MILP Problem	2	
	2.2	Cutting Plane Method	2	
	2.3	Branch and Bound Method	2	
		Problems (Practicum)	2	
	Text 1: Chapter 6 – Sections: 6.3, 6.5, 6.6 & 6.8			
3		**Flow in Networks**		**15**
	3.1	Graphs: Definition and Notations	3	
	3.2	Minimum Path Problem, Spanning Tree of MinimumLength.	3	
	3.3	Scheduling of Sequential Activities, Maximum FlowProblem.	3	
		Problems (Practicum)	3	
	Text 1: Chapter 5 – Sections: 5.2 to 5.7			
4		**Non Linear Programming**		**25**
	4.1	Taylor's Series Expansions Necessary and SufficientCondition	4	
	4.2	Fibonacci and Golden Section Search	4	
	4.3	Hooke and Jeeves Search	4	
	4.4	Gradient Projection	5	
	4.5	Lagrange Multipliers	5	
	4.6	Equality Constrained Optimization: ConstrainedDerivatives	5	
		Problems (Practicum)	4, 5	
	Text 1: Chapter 11 – Sections: 11.2 to 11.7			

5	**Teacher Specific Contents** *(This can be either classroom teaching, practical session, field visit etc. asspecified by the teacher concerned)* **This content will be evaluated internally**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**					
	Direct Instruction: Explicit Teaching and E-learning. Interactive instruction: Engage in collaborative learning through active participation, seminars, group assignments, group discussions, and presentations by individual students orgroup representatives					
Assessment Types	**MODE OF ASSESSMENT**					
	A	**Continuous Comprehensive Assessment (CCA)**				
		Components			Mark Distribution	
		Teacher Specific Content			20 Marks	
		Quiz in any mode			5 Marks	
		Assignment			5 Marks	
	B	**Semester End Examination (Written)**				
		Question Pattern [Time 2 Hours, Maximum Marks 70]				
		Module	Part A **2 Marks**	Part B **5 Marks**	Part C **10 Marks**	Total
		I	3	2	1	**6**
		II	3	3	1	**7**
		III	3	2	1	**6**
		IV	3	2	1	**6**
		Total no of questions	**12**	**9**	**4**	**25**
		Number of questions to beanswered	**10**	**6**	**2**	**18**
		Total Marks	**20**	**30**	**20**	**70**

TEXT BOOKS:

1. Mittal, K. V. and Mohan, C. *Optimization Methods in Operations Research and Systems Analysis*; *5th Edition*, New Age Publishers, 2020.

2. Ravindran, Philips, Solberg. *Operations Research Principles and Practice*; *2nd Edition*, Wiley India Publishers, 2012.

SUGGESTED READINGS:

1. Swarup, K. Gupta , P. K., and Man Mohan, *Operations Research*. S. Chand and SonsPublishers, 2010.
2. Sharma , S. D. *Operations Research Theory, Methods And Applications*;, Kedar Nath Ram Nath Publishers, 2014.

ADVANCED READING:

1. Taha, A. H. Operations Research: An Introduction. Pearson Publishers, 2012.

SOME SUGGESTIONS FOR TEACHER SPECIFIC CONTENTS:

- Organize interactive discussions where students can explore the conceptual foundations of duality in linear programming. Encourage them to discuss real-world applications and implications of duality theorems. Challenge students to delve into the proofs of duality theorems. This can be done individually or in groups. They can present their understanding of the proofs to the class or in a written format.
- Challenge students to implement the Cutting Plane Method or Branch and Bound Method for solving optimization problems. They can use programming languages likePython or MATLAB or others. Encourage them to test their implementations on various problems and analyse the results.
- Demonstrate real-world applications of minimum spanning tree problems and flow in networks. This could include applications in logistics, telecommunications, project management, and network design.
- Assign small optimization problems where students can apply the Hooke and Jeeves Search method and Gradient Projection method. These problems could encompass scenarios in engineering, finance, or operations research.

Internship & Project

FYUGP-Mathematics

1. Internship: Students can earn a maximum of 2 credits (4th Semester)

The internship can be in the field of Mathematics/ Interdisciplinary field related to Mathematics (Example –Pure/Applied Mathematics, Applied Probability, Computer Science, Banking, Applied Economics etc.)

The student is expected to undergo training in a reputed organisation/ Institution/any other for a minimum period of 21 days and submit the final consolidated report along with the completion certificate from the organization at the end.

The student will be evaluated at the college level based on the reportsubmitted followed by presentation/viva.

2. Project and Comprehensive Viva -Voce: Students can earn a maximum of 12 credits (8th Semester)

a) The project work should be done under the supervision of a teacher of the concerned department.

b) There will be an internal assessment and an external assessment for project work.

c) Project work is evaluated based on the presentation of the student and viva voce on the project.

d) External evaluation of the project work will be done by one/two external examiners from different colleges and one internal examiner from the concerned college.

e) The final external mark of the project will be calculated by taking the average of the marks given by the two external examiners and the internal examiner.