File Ref.No.71589/Ac A V (A)/2024/UOK

UNIVERSITY OF KERALA

(Abstract)

Four Year UG Programme in Mathematics - Revised Syllabus for Semester I with effect from 2025 admissions - Approved - Orders issued.

Ac A V (A)

8666/2025/UOK Dated: 06.10.2025

Read:-1. UO No. 32912/4/2024/ UOK dtd 02.07.2024.
2. UO No. 218/2025/UOK dtd 08.01.2025.
3. Minutes of the Additional Meeting of the BoS in Mathematics (UG) held on 28.07.2025.
4. Endorsement of the Dean, Faculty of Science vide E-mail dated 14.09.2025.
5. UO No. 8042/2025/UOK dtd 18.09.2025

ORDER

The Scheme and Syllabi for the courses in Mathematics under FYUGP, implemented w.e.f 2024 admissions was approved by the Academic Council held on 10.05.2024 and U.O vide paper read as (1) above was issued accordingly. The revised syllabus for Semesters II and III of FYUGP in Mathematics were implemented w.e.f 2024 admissions, vide U.O read as (2) and (5) above respectively.

The Board of Studies in Mathematics (UG) vide paper read as (3) above, recommended the revised Syllabus for Semester I for FYUGP in Mathematics w.e.f 2025 admissions. The Dean, Faculty of Science, vide paper read as (4) above, endorsed the recommendation of the Board of Studies in Mathematics (UG) and the revised Syllabus.

Sanction has been accorded by the Vice-Chancellor, for effecting the modified Syllabus for Semester I of FYUGP in Mathematics w.e.f. 2025 admissions, as recommended by the Board of Studies in Mathematics (UG) and as endorsed by the Dean, Faculty of Science. (Syllabus appended).

Orders are issued accordingly.

MEERA RAJ S

DEPUTY REGISTRAR
For REGISTRAR

To

1. Principals of all Affiliated Colleges.
2. Dean, Faculty of Science
3. Chairman Bos in Mathematics (UG)
4. Director, Computer Centre
5. PA to Registrar / CE
6. DR/AR (Exams)
6. All tabulation sections
7. PRO / Enquiry.

Forwarded / By Order
Sd/-
Section Officer

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The document is digitally approved. Hence signature is not needed.

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University of Kerala

Four Year Under Graduate Programme (UoK FYUGP) (2025 Admission Onwards)

Syllabus (First Semester)

Major Discipline Mathematics

May 2025

Last edited on August 6, 2025

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT100				
Course Title	Foundations of Mathematics				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Basic understanding on the concepts and operations on matrices 2. Understanding on the concept of a system of linear equations. 3. Basic knowledge of the set number system.				
Course Summary	This course includes set theory, determinants and matrices, number theory and solution of system of equations using matrices and number theory				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Fundamental Terminology in Proof Techniques**		**9**
	1	Statements, statements with quantifiers, negation of statements with quantifiers, statements involving multiple quantifiers, compound statements, negation of compound statements, implications, converse, if and only if, contrapositive of implications, Proofs in Mathematics (Indirect proofs: proof by contradiction, proof by Induction, counter examples can be omitted) (Chapter 1: Sections 1.1 to 1.5 Text[1])	

Module	Unit	Contents	Hrs
II	**Proof techniques and elementary number theory**		**9**
	2	Mathematical induction, The division algorithm, Pigeonhole principle, divisibility relation, inclusion-exclusion principle, prime and composite numbers, infinitude of primes– Sections 1.3, 2.1 (exclude the topics marked as optional), 2.5 (Topics Primes and Pi and exclude the rest in this section) from Text [3])	
III	**Primes and composites**		**9**
	3	GCD, linear combination of integers, pairwise relatively prime integers, the Euclidean algorithm for finding GCD, The fundamental theorem of arithmetic, canonical decomposition of an integer into prime factors Section 3.1 (excluding Lemma 3.1, Theorem 3.2, Theorem 3.3), section 3.2 (Excluding the topics marked as optional, excluding Lemma 3.2, Theorem 3.12), Section 3.3 (Excluding Theorem 3.14) from Text [3])	
IV	**System of linear equations and solutions**		**9**
	4	Systems of Linear Equations, Gaussian Elimination, Elementary Matrices and a Method for Finding A^{-1}, Number of Solutions of a Linear System, Applications of Linear Systems –Network Analysis (Chapter 1: Section 1.1, 1,2, 1.5, 1.9 (Network analysis only) of Text[2])	
V	**Suggestions for the teacher designed module**		**9**
	5	Relation: Product sets, Relations, Types of Relations, Equivalence Relations, Partial Ordering Relations Functions: Functions, One–to-One, Onto and Invertible Functions., Different types of matrices – diagonal, triangular, symmetric, Solving system of equations using Cramer's rule, Solving Linear Systems by Matrix Inversion,Applications of linear systems - balancing chemical equations, polyomial interpolation, LCM and related problems	

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Costructing sets, operations on them like union, intersection, complements
2. Demonstrating basic arithmetic operators $+, -, *, \hat{}$, , modulo operator%
3. Forming matrices of different orders
4. Forming identity, zero, scalar matrices
5. Operations on matrices (multiplication, inverses, transposes, cofactor, adjoint)

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6. Forming systems of linear equations using symbolic variables
7. Forming matrices for systems, forming augmented matrices
8. Row reduction operations on matrices
9. Finding remainder and quotient
10. Problems using inclusion-exclusion principle
11. Determining if a number is a prime, finding list of primes
12. Using Euler ϕ function
13. Canonical decomposition

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbooks

1. Ajit Kumar, S Kumaresan, B K Sarma, A foundation course in Mathematics, Narosa Publications, New Delhi 2018
2. H Anton, C Rorres. Elementary linear algebra, 11th Edition, John Wiley & Sons.
3. Thomas Koshy, Elementary Number Theory with Applications, 2nd Edition, Academic Press, 2007.

References

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw-Hill, 2011.
2. Gilbert Strang, Introduction to Linear Algebra , 5th Edition, 2005.
3. G A Jones, J M Jones, Elementary Number Theory, Springer, 1998.
4. Lee W. Johnson, R Dean Riess, Jimmy T. Arnold, Introduction to Linear Algebra, Fifth Edition, Addison Wesley, 2019.
5. Seymour Lipschutz. Set Theory and Related Topics, 3rd Edition, Schaum's outline, 1998.

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Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P5. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P6. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

P7. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.html

Course Outcomes

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CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Describe the basic concept of set theory, determinants, Matrices and numbers	PSO1, PO1, 2, 4, 8	U	F,C	L	
CO 2	Solve system of linear equations using determinants, Matrices	PSO2, PO1, 2, 3, 4, 7, 8	Ap	P	L	
CO 3	Illustration of Mathematical Induction, Division Algorithm and Euclidean Algorithm	PSO1, PO1, 2, 3, 4, 6, 7, 8	U	F,C	L	
CO 4	Categorise functions based on the properties	PSO4, PO1	An	F,C	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	2	1	1	2	2	2	1	3	1	1	2	2
CO2	2	3	2	2	1	1	2	3	1	2			1	2
CO3	3	2	2	1	1	1	3	2	1	3			1	1
CO4	2	2	1	3	1	1	3	1	1	1		1	1	1

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam

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- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT101				
Course Title	Differential Calculus and Linear Algebra				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Derivatives of functions 2. Matrices				
Course Summary	This course provides a comprehensive idea of differentiation, its applications and solutions of linear equations.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Differentiation**		**9**
	1	Derivative of a function, Implicit differentiation, Derivatives of logarithmic, exponential and inverse trigonometric functions Analysis of functions - Increasing, Decreasing, concavity, Chapter 2: Sections 2.2, 2.7, Chapter 6 : Section 6.2 (differentiation only), 6.3 (differentiation only), Chapter 3: section 3.1 of Text [2]	
II	**Applications of Differentiation**		**9**
	2	Analysis of functions - Relative extrema, Absolute maxima and minima, Applied maxima and minima problems. Rolle's theorem (without proof) and upto Mean value theorem (without proof). chapter 3: section 3.2 (Exclude analysis of polynomials), 3.4, 3.5, 3.6, 3.8 of Text [2].	

Module	Unit	Contents	Hrs
III		**System of Linear equations**	**9**
	3	Linear systems of equations, Coefficient matrix, Augmented matrix, Elementary row operations, Guass elimination, Rank of a matrix, Existence and uniqueness of solutions Chapter 7: Section 7.3, 7.4 (rank of a matrix only), 7.5 (omit proof) Text [1].	
IV		**Eigen values and Diagonalization**	**9**
	4	Eigen values and eigen vectors, Diagonalization of Matrices. Chapter 8: Section 8.1, 8.4(omit quadratic forms) of Text [1]	
V		**Suggestions for teacher designed module**	**9**
	5	Tangent lines and Rates of change, Relative rates Sections 2.1, 2.8, graphing of polynomials Section 3.2, 3.3 of Text [2]. Rectilinear motion (exclude analysing the position versus time curve), Solving systems of equations using Cramer's rule, Some applications of eigen value problems Section 8.2 of Text [1].	

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Demonstrate the basic arithmetic operations (`+, -, *, ^, /`)
2. Demonstrate how to use the standard trigonometric, log, exponential functions, and how to evaluate them at given real numbers
3. Define polynomials of various order, evaluate them
4. Define functions, and evaluate one-sided limits
5. Define functions, and evaluate two-sided limits
6. Demonstrate the plot command with various options (line style, color, thickness etc)
7. Define functions, find their derivatives of different orders
8. Mean value theorem - verification and demonstration via sketching the curve and tangent
9. Finding maxima, minima using first and second derivative tests.
10. Finding points of inflection and sketching them
11. Forming matrices of different orders
12. Forming identity, zero, scalar matrices

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13. Operations on matrices (multiplication, inverses, transposes, cofactor, adjoint)
14. Forming systems of linear equations using symbolic variables
15. Forming matrices for systems, forming augmented matrices
16. Row reduction operations on matrices
17. Finding determinants of square matrices

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbooks

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10^{th} Edition Wiley, 2011
2. Howard Anton, Irel Bivens, Stephens Davis, *Calculus* 10^{th} Edition Wiley, 2012

References

1. G. B. Thomas, R. L. Finey, *Calculus*, 9^{th} Edition, Addison-Weseley Publishing Company, 2004
2. Joel Hass, Maurice D, Weir, *Thomas Calculus Early Transcendentals* 12^{th} Edition, Addison-Weseley Publishing Company, 2006
3. J. Stewart, *Calculus with Early Transcendentals Functions* 7^{th} Edition, Cengage India, 2008
4. David C Lay, Linear Algebra and its Applications, Pearson, 2003
5. T.S. Blyth, E.F. Robertson, Linear Algebra, Second Edition, Springer, 2013

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

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P5. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P7. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

P8. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.html

Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand the fundamental concepts of Differentiation	PSO1, 2	U	F,C	L	
CO 2	Explore Differentiation techniques to functions involving vectors and matrices	PSO 2,4	An, C	C, M	L	
CO 3	Develop problem-solving skills through the application of differentiation concepts and systems of linear equations	PSO 2,3	An, C	P, M	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	2	2	3	3	3	-	1	-	-	2	1	1
CO2	1	3	1	2	1	1	1	1	3	-	-	2	1	1
CO3	1	3	2	3	2	3	1	3	3	-	-	3	1	1

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

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Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- End Semester Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	—-	—-	✓
CO2	✓	✓		✓
CO3	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT102				
Course Title	Differentiation, Sequences and Series				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Differentiation 2. Integration				
Course Summary	This course provides a detailed study of differentiation and convergence of sequence and series				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Differentiation**		**9**
	1	Tangent lines and rate of change, The derivative function[Chapter 2 Sections 2.1, 2.2 of Text 1]	
	2	The Chain Rule, Implicit Differentiation [(Chapter 2 Sections 2.6, 2.7 of Text 1]	
II	**Differentiation of exponential and logarithmic functions**		**9**
	3	Exponential and logarithmic functions (review only) [Chapter 6 Section 6.1 of Text 1]	
	4	Derivatives involving Exponential and logarithmic functions [Chapter 6 Section 6.2 of Text 1]	
	5	L'Hˆopital's rule [Chapter 6 Section 6.5 of Text 1]	
III	**Sequences and Series**		**9**
	6	Sequences, their limits, convergence and related theorems (without proof) [Chapter 9 Sections 9.1, 9.2 of Text 1]	

Module	Unit	Contents	Hrs
	7	Infinite series, their convergence and sums, geometric Series and harmonic series [Chapter 9 Section 9.3 of Text 1]	
IV	**Tests for Convergence and Divergence**		**9**
	8	Algebraic properties of infinite series, Integral test, p-series(without proof) [Chapter 9 Section 9.4 of Text 1]	
	9	Comparison test, limit comparison test, Ratio test, Root test [Chapter 9 Section 9.5 of Text 1]	
	10	Alternating Series - Absolute and conditional Convergence, Ratio test for absolute convergence, Power series, Maclaurin and Taylor Polynomials [Chapter 9 Sections 9.6, 9.7 of Text 1]	
V	**Teacher designed module - suggested topics**		**9**
	11	Introduction to Techniques of Differentiation, The Product and Quotient Rules, Derivatives of Trigonometric Functions (review only)	
	12	Tangent lines and limits (review only), One sided limits (review only), Limits at infinity, Infinite limits, Continuity (up to continuity of composite functions)[Chapter 1 Sections 1.1, 1.3, 1.4 and 1.5 of Text 1]	
	13	Maclaurin and Taylor series [Section 6.3 of Text 1]	

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Demonstrate the basic arithmetic operations (+, −, ∗, ^, /)
2. Demonstrate how to use the standard trigonometric, log, exponential functions, and how to evaluate them at given real numbers
3. Define polynomials of various order, evaluate them
4. Define functions, and evaluate one-sided limits
5. Define functions, and evaluate two-sided limits
6. Demonstrate the plot command with various options (line style, color, thickness etc)
7. Define functions, find their derivatives of different orders
8. Defining sequences, printing certian number of terms from it
9. Computing partial sums of series
10. Computing Maclaurin series
11. Computing Taylor polynomials

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A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbook

1. Howard Anton, Irl Bivens, Stephens Davis, Calculus 10th Edition ,Wiley, 2012

References

1. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.
2. K. F. Riley, .M. P. Hobson, S. J. Bence, Mathematical Methods for Physics and Engineering, Third Edition, Cambridge University Press, 2006.
3. J Stewart, Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited, 2008.
4. Mary L Boas, Mathematical Methods in Physical Science, 3rd Edition, 2006.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

P5. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P7. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

P8. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.html

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Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Calculate the solution of algebraic and transcendental equation using numerical methods	PO 2, PSO1, 2,3	U, Ap	F,C	L	
CO 2	Apply numerical techniques to interpolate data points effectively	PO1, PSO1, 2,3	U, Ap	F,C	L	
CO 3	Apply numerical techniques for differentiation and integration	PO2, PSO1, 2,3	U, Ap	F,C	L	
CO 4	Calculate the solution of ordinary differential equations using numerical methods	PO2, PSO1, 2,3	U, Ap	F,C	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO2	3	3	2	-	-	-	3	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	3	-	-	-	-	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam

- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT103				
Course Title	Differentiation and Linear System of Equations				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Functions and Limits, Techniques of differentation 2. Matrices Solution of system of linear equations in two variables				
Course Summary	This course provides brief idea about differentiation and basics of Linear Algebra				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Differentiation**	**9**
	1	The Chain Rule, Implicit Differentiation *(Chapter 2 Sections 2.6, 2.7 of Text [1])*	
II		**Differentiation of exponential and logarithmic functions**	**9**
	2	Derivatives involving Exponential and logarithmic functions *(Chapter 6 Section 6.2 (excluding topics and problems involving integration) of Text [1])*	
	3	L'Hôpital's rule *(Chapter 6 Section 6.5 of Text [1])*	
III		**Matrices and Systems of linear equations**	**9**
	4	Linear Systems of Equations, Gauss Elimination, Linear Independence, Rank of a Matrix. *(Sections 7.3, 7.4 of Text [2] (Exclude vector space))*	

Module	Unit	Contents	Hrs
	5	Solutions of Linear Systems: Existence, Uniqueness *(Chapter 7 Section 7.5 of Text [2] (omit proofs of theorems))*	
IV	**Eigen values and Eigen vectors**		**9**
	6	The Matrix Eigenvalue Problem. Determining Eigenvalues and Eigenvectors *(Chapter 8 Section 8.1 of Text [2])*	
V	**Suggestions for the teacher designed module**		**9**
	7	Tangent lines and limits (review only), One sided limits (review only), Exponential and logarithmic functions, Symmetric, Skew-Symmetric, and Orthogonal Matrices, Diagonalization	

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Demonstrate the basic arithmetic operations (`+, -, *, ^, /`)
2. Demonstrate how to use the standard trigonometric, log, exponential functions, and how to evaluate them at given real numbers
3. Define polynomials of various order, evaluate them
4. Define functions, and evaluate one-sided limits
5. Define functions, and evaluate two-sided limits
6. Demonstrate the plot command with various options (line style, color, thickness etc)
7. Define functions, find their derivatives of different orders
8. Forming matrices of different orders
9. Forming identity, zero, scalar matrices
10. Operations on matrices (multiplication, inverses, transposes, cofactor, adjoint)
11. Forming systems of linear equations using symbolic variables
12. Forming matrices for systems, forming augmented matrices
13. Row reduction operations on matrices

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

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Textbooks

1. H Anton, Irl Bivens, S Davis, *Calculus*, 10th Edition, John Wiley & Sons. 2012.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley Publishers, 10th Edition, 2018.

References

1. T S Blyth, E F Robertson, *Linear Algebra*, Second Edition, Springer, 2013.
2. David C Lay, *Linear Algebra and its applications*, Pearson, 2003.
3. Joel Hass, Maurice D. Weir, *Thomas' Calculus Early Transcendentals*, 12th Edition, Addison-Weseley Publishing Company, 2004.
4. Lee W. Johnson, R Dean Riess, Jimmy T. Arnold, *Introduction to Linear Algebra*, Fifth Edition, Addison Wesley, 2001.
5. J Stewart, *Calculus with Early Transcendental Functions*, 7th Edition, Cengage India Private Limited, 2004.
6. Thomas Banchoff, John Wermer, *Linear Algebra Through Geometry*, 2nd Edition, Springer, 2012.
7. G B Thomas, R L Finney, *Calculus*, 9th Edition, Addison-Weseley Publishing Company, 2006.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

P5. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P7. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

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P8. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.html

Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand the concept of differentiability	PSO 1	U	F, C	L	
CO 2	Apply the concept of differentiability	PSO 2, 4	Ap, An	P	L	
CO 3	Understand the concepts of Matrix operations and their algebraic properties, System of linear equations and their Matrix representation, Gauss Elimination	PSO 1	U	F, C	L	
CO 4	Able to find the eigen values powers of matrices and diagonalization of matrices	PSO 2, 4	Ap, An	P	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO2	-	2	-	2	-	-	-	-	-	-	-	2	-	1
CO3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO4	-	2	-	2	-	-	-	-	-	-	-	2	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar

- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓			✓
CO2	✓	✓		✓
CO3	✓			✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT104				
Course Title	Differentiation and Theory of Numbers				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Differentiation 2. Integration				
Course Summary	This course provides a brief idea about differentiation and theory of numbers.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Differentiation**		**9**
	1	Tangent lines and rate of change, The derivative function[Chapter 2 Sections 2.1, 2.2 of Text 1]	
	2	The Chain Rule, Implicit Differentiation [(Chapter 2 Sections 2.6, 2.7 of Text 1]	
II	**Differentiation of exponential and logarithmic functions**		**9**
	3	Exponential and logarithmic functions (review only) [Chapter 6 Section 6.1 of Text 1]	
	4	Derivatives involving Exponential and logarithmic functions [Chapter 6 Section 6.2 of Text 1]	
	5	L'Hospital's rule [Chapter 6 Section 6.5 of Text 1]	

Module	Unit	Contents	Hrs
III		**Divisibility**	**9**
	6	Mathematical induction : Well-ordering Principle, Weak version of induction, Principle of Mathematical induction [Chapter 1 Sections 1.3 of Text 2 (Exclude all from Example 1.12)]	
	7	Division Algorithm : Theorem 2.1, Example 2.1, Div and Mod operators, Theorem 2.2, Example 2.2, Theorem 2.3,Theorem 2.4. Exclude the subsections marked as *Optional* [Chapter 2 - Section 2.1 of Text 2]	
	8	Prime and Composite Numbers : Prime numbers, composite numbers, Lemma 2.1, Theorem 2.8, Theorem 2.9, Example 2.22. Exclude the subsections marked as *Optional*, The topics in this section is covered upto Example 2.22 [Chapter 2 - Section 2.5 of Text 2]	
IV		**The Euclidean Algorithm**	**9**
	9	Greatest Common Divisor : Definition of GCD, Relatively prime integers, Lemma 3.1, Theorem 3.2, Theorem 3.4. Exclude the subsections marked as *Optional* [Chapter 3 Section 3.1 of Text 2]	
	10	The Euclidean Algorithm : Theorem 3.11, Example 3.5, Example 3.6, The Euclidean algorithm, Example 3.7, Example 3.8. Exclude the subsections marked as *Optional* [Chapter 3 Section 3.2 of Text 2]	
	11	The Fundamental Theorem of Arithmetic : Lemma 3.3, Lemma 3.4, Corollary 3.9, Theorem 3.13(Without proof), Canonical decomposition, Example 3.9, Example 3.10. The topics in this section is covered upto Example 3.10. [Chapter 3 Sections 3.3 of Text 2]	
V		**Teacher designed module - suggested topics**	**9**
	12	Tangent lines and limits (review only), One sided limits (review only), Limits at infinity, Infinite limits, Continuity (up to continuity of composite functions)[Chapter 1 Sections 1.1, 1.3, 1.4 and 1.5 of Text 1]	
	13	Introduction to Techniques of Differentiation, The Product and Quotient Rules, Derivatives of Trigonometric Functions (review only) [Chapter 2: Sections 2.3, 2.4, 2.5 of Text 1]	
	14	Strong version of induction [Section 1.3 - Theorem 1.7 of Text 2]	
	15	Union, Intersection and Complement, The inclusion exclusion principle[Chapter 2 - Section 2.1 - Theorem 2.6 of Text 2]	
	16	Least Common Multiple : Definition of LCM, Important Observation, Example 3.14, Theorem 3.17, Example 3.15, Corollary 3.10. [Chapter 3 Sections 3.4 of Text 2]	

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Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Demonstrating basic arithmetic operators `+, −, ⋆, ^,` , modulo operator`%`
2. Demonstrate how to use the standard trigonometric, log, exponential functions, and how to evaluate them at given real numbers
3. Define polynomials of various order, evaluate them
4. Define functions, and evaluate one-sided limits
5. Define functions, and evaluate two-sided limits
6. Demonstrate the plot command with various options (line style, color, thickness etc)
7. Define functions, find their derivatives of different orders
8. Finding remainder and quotient
9. Finding Gcd using Euclidean algorithm
10. Problems using inclusion-exclusion principle
11. Determining if a number is a prime, finding list of primes
12. Using Euler ϕ function
13. Canonical decomposition

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbook

1. Howard Anton, Irl Bivens, Stephens Davis, Calculus 10th Edition ,Wiley,2012.
2. Thomas Koshy, Elementary Number Theory with Applications, 2nd Edition, Academic Press, 2007.

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1. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.

2. K. F. Riley, .M. P. Hobson, S. J. Bence, Mathematical Methods for Physics and Engineering, Third Edition, Cambridge University Press, 2006.

3. J Stewart, Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited, 2008.

4. Mary L Boas, Mathematical Methods in Physical Science, 3rd Edition, 2006.

5. David M. Burton, Elementary Number Theory, 7th Edition, McGraw Hill, 2011.

6. G A Jones, J M Jones, Elementary Number Theory, Springer, 1998.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

P5. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P7. Robert A. Beezer, *A First Course in Linear Algebra* http://linear.ups.edu/html/sage.html

P8. Sagemath documentation – Linear Algebra https://doc.sagemath.org/html/en/tutorial/tour_linalg.html

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Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Calculate the solution of algebraic and transcendental equation using numerical methods	PO 2, PSO1, 2,3	U, Ap	F,C	L	
CO 2	Apply numerical techniques to interpolate data points effectively	PO1, PSO1, 2,3	U, Ap	F,C	L	
CO 3	Apply numerical techniques for differentiation and integration	PO2, PSO1, 2,3	U, Ap	F,C	L	
CO 4	Calculate the solution of ordinary differential equations using numerical methods	PO2, PSO1, 2,3	U, Ap	F,C	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO2	3	3	2	-	-	-	3	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	3	-	-	-	-	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam

- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT105				
Course Title	Differentiation and Complex Numbers				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Differentiation 2. Integration				
Course Summary	This course provides basics on differentiation and complex numbers				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Differentiation**		**9**
	1	Tangent lines and rate of change, The derivative function. (Chapter 2 Sections 2.1, 2.2 of Text [1])	
	2	The Chain Rule, Implicit Differentiation (Chapter 2 Sections 2.6, 2.7 of Text [1])	
II	**Differentiation of exponential and logarithmic functions**		**9**
	3	Exponential and logarithmic functions (review only) (Chapter 6 Section 6.1 of Text [1])	
	4	Derivatives involving Exponential and logarithmic functions (Chapter 6 Section 6.2 of Text [1])	
	5	L'Hˆopital's rule (Chapter 6 Section 6.5 of Text [1])	
III	**Complex Numbers**		**9**
	6	Sums and Products, Basic Algebraic Properties (Chapter 1 Sections 1, 2 of Text [2])	

Module	Unit	Contents	Hrs
	7	Further Properties of complex numbers, Vectors and Moduli (Chapter 1 Sections 3, 4 of Text [2])	
	8	Complex Conjugates [Chapter 1 Section 5 of Text 2]	
IV	**Argument and roots of complex numbers**		**9**
	9	Arguments of Products and Quotients (Chapter 1 Section 8 of Text [2])	
	10	Roots of Complex Numbers, Examples (Chapter 1 Sections 9, 10 of Text [2])	
V	**Teacher designed module - suggested topics**		**9**
	11	Tangent lines and limits (review only), One sided limits (review only), Limits at infinity, Infinite limits, Continuity (up to continuity of composite functions) (Chapter 1 Sections 1.1, 1.3, 1.4 and 1.5 of Text [1])	
	12	Introduction to Techniques of Differentiation, The Product and Quotient Rules, Derivatives of Trigonometric Functions (review only) (Chapter 2: Sections 2.3, 2.4, 2.5 of Text [1])	
	13	Exponential Form, Products and Powers in Exponential Form (Chapter 1 Sections 6, 7 of Text [2])	

Practical sessions and examinations – 30 hours

All the topics mentioned above should be used for practical sessions using SageMath software. Some useful resources for solving these problems using the SageMath software are given against each problem/ type of problems.

1. Introducing the SAGEMATH interface, SAGE cell server:
   (a) SageMath – documentation
   `https://doc.sagemath.org/html/en/tutorial/introduction.html`
   (b) Online SageMath server `https://sagecell.sagemath.org/`
2. Introduce basic arithmetic involving operators +,-,/, exponentiation; functions like $\sin$, $\cos$, $\tan$, e, $\log$, $sqrt$, constant π
3. Defining and using lists, dictionaries, sets, and accessing elements in lists and dictionaries.
4. Defining variables using var
5. Using `diff` command to find derivatives of standard functions and higher order derivatives.
6. Find derivatives of exponential and logarithmic functions.
7. Defining complex numbers, accessing its real and imaginry parts
8. Computing argument, modulus of complex numbers

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9. Plotting Complex numbers as vectors on plane
10. Verifying the relation between arguments of individual complex numbers and their products, quotients
11. Finding roots of complex numbers

A record should be maintained with atleast 7 problems from the main topics/teacher designed topics. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbook

1. Howard Anton, Irl Bivens, Stephens Davis, Calculus 10th Edition ,Wiley,2012.
2. James Ward Brown, Ruel V. Churchill, Complex Variables and Applicatons, 8th edition, McGraw Hill, 2001.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

P5. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

P7. SageMath documentation – Double precision floating point complex numbers https://doc.sagemath.org/html/en/reference/rings_numerical/sage/rings/complex_double.html

P8. Ask SageMath Q & A https://ask.sagemath.org/questions/scope:all/sort:age-desc/tags:complex-analysis/page:1/

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References

1. G B Thomas, R L Finney, Calculus, 9th Edition, Addison-Weseley Publishing Company, 2004.
2. K. F. Riley, .M. P. Hobson, S. J. Bence, Mathematical Methods for Physics and Engineering, Third Edition, Cambridge University Press, 2006.
3. J Stewart, Calculus with Early Transcendental Functions, 7th Edition, Cengage India Private Limited, 2008.
4. Mary L Boas, Mathematical Methods in Physical Science, 3rd Edition, 2006.
5. Dennis G. Zill, Patric D Shanahan, A First Course in Complex Analysis with Applications, Jones and Bartlett Publishers, 2003.
6. Edward B. Saff, Arthur David Snider, Fundamentals of Complex Analysis with Applications to Engineering and Science, 3rd Edition, Pearson Education India, 2017.

Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Calculate the solution of algebraic and transcendental equation using numerical methods	PO 2, PSO1, 2,3	U, Ap	F,C	L	
CO 2	Apply numerical techniques to interpolate data points effectively	PO1, PSO1, 2,3	U, Ap	F,C	L	
CO 3	Apply numerical techniques for differentiation and integration	PO2, PSO1, 2,3	U, Ap	F,C	L	
CO 4	Calculate the solution of ordinary differential equations using numerical methods	PO2, PSO1, 2,3	U, Ap	F,C	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO2	3	3	2	-	-	-	3	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	3	-	-	-	-	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT106				
Course Title	Number Theory and Linear System of Equations				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	4	-	-	4
Pre-requisites	1. Natural Numbers 2. Matrices				
Course Summary	This course provides a study on number theory and linear system of equations				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**The Euclidean Algorithm**	**12**
	1	The division algorithm, Pigeonhole principle, divisibility relations, inclusion-exclusion principle (Chapter 2 Sections 2.1, 2.5 of Text [2] The topics from the subsection 'A Number-Theoretic Function' onwards are excluded. But Theorem 2.12 and Lemma 2.25 to be discussed.)	
	2	Prime and composite numbers, infinitude of primes, GCD, linear combination of integers, pairwise relatively prime integers, the Euclidean algorithm for finding GCD (Chapter 3 Section 3.1 of Text [2]. The subsections marked as optional, Theorems 3.1, 3.2, 3.3, 3.12, 3.14, and Lemma 3.2 are excluded.)	

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Module	Unit	Contents	Hrs
II		**Congruences**	**12**
	3	The fundamental theorem of arithmetic, canonical decomposition of an integer into prime factors (Chapter 3 Sections 3.3 of Text [2]. The subsections marked as optional, Theorem 3.14 are excluded.)	
	4	LCM (Chapter 3 Section 3.4 of Text [2])	
III		**Matrices and Systems of linear equatios**	**12**
	5	Linear Systems of Equations, Gauss Elimination, Linear Independence, Rank of a Matrix.	
	6	Solutions of Linear Systems: Existence, Uniqueness	
	7	Determinants, Cramer's Rule – 2×2 matrices only (Chapter 7 Section 7.7 of Text [2])	
	Chapter 7: Sections 7.2, 7.4 (avoid vector space), 7.5 omit proofs of theorems of Text [2]		
IV		**Eigen values and Eigen vectors**	**12**
	8	The Matrix Eigenvalue Problem. Determining Eigenvalues and Eigenvectors – 2×2 matrices only	
	9	Symmetric, Skew-Symmetric, and Orthogonal Matrices – 2×2 matrices only	
	10	Diagonalization 2×2 matrices only	
	Chapter 8 Section 8.1, 8.4 except eigen bases of Text [2]		
V		**Suggestions for teacher designed module**	**12**
	For internal assessment examinations only.		
	11	Geometry of linear systems Cramer's rule Diagonalization - – 3×3 matrices Orthogonal Matrices, Quadratic Forms Mathematical induction, recursion, The division algorithm (Chapter 1 Sections 1.3, 1.4 of Text [2]) Congruences, modular exponentiation (Chapter 4 Section 4.1 of Text [2].)	
	These topics can be found on Chapters 1 and 4 of Text [1] and Chapter 7, 8 of Text [2]		

Textbooks

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley, 10^{th} Edition, 2011.
2. Thomas Koshy, *Elementary Number Theory with Applications*, 2^{nd} Edition, Academic Press, 2007.

References

1. T S Blyth, E F Robertson, *Linear Algebra*, Second Edition, Springer, 2013.
2. David C Lay, *Linaer algebra and its applications*, Pearson, 2003.
3. David M. Burton, *Elementary Number Theory*, 7th Edition, McGraw Hill, 2011.
4. G A Jones, J M Jones, *Elementary Number Theory*, Springer, 1998.
5. Lee W. Johnson, R Dean Riess, Jimmy T. Arnold, *Introduction to Linear Algebra*, Fifth Edition, Addison Wesley, 2019
6. Thomas Banchoff, John Wermer, *Linear Algebra Through Geometry*, 2nd Edition, Springer, 2012.

E-resources

1. https://www.khanacademy.org

Course Outcomes

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CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Examine integrated approach to number theory	PSO 1, 3, PO2	U	F, C	L	
CO 2	Apply the concept of congruences	PSO 2, 3, 4, PO1, 2, 5, 6	Ap, An	P	L	
CO 3	Understand the concepts of Matrix operations, their algebraic properties, System of linear equations and their Matrix representation, Gauss Elimination	PSO 1, PO1, 2, 5, 6	U	F, C	L	
CO 4	Able to find the eigen values of powers of matrices and diagonalization of matrices	PSO 2, 4, PO1, 2, 6	Ap, An	P	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO3	2	-	1	-	-	-	-	1	-	-	-	1	-	-
CO4	-	2	2	1	-	-	1	2	-	-	1	1	-	-
CO3	2	-	-	-	-	-	2	1	-	-	1	2	-	-
CO4	-	2	-	2	-	-	2	2	-	-	-	2	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar

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- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓			✓
CO2	✓	✓		✓
CO3	✓			✓
CO4	✓	✓		✓

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University of Kerala

Descipline	Mathematics				
Course Code	UK1DSCMAT107				
Course Title	Relations, Functions and Number theory				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	4	-	-	4
Pre-requisites	Sets				
Course Summary	Sets, relations, functions and basics of number theory				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Relations and Functions I**	**12**
	1	Set operations, Relations, Types of relations, Some operations on relations, Composition of relations, Properties of relations, Equivalence classes, Partition of a set, Partitioning of a set induced by an equivalence relation These topics can be found in Chapter 5 of Text [2].	
II		**Relations and Functions II**	**12**
	2	Representation of relations by graphs, HASSE diagrams for partial orderings, Terminology related to posets, Definitions, Lattices: Definition and Examples, Properties of lattices (without proof). These topics can be found in Chapter 5 of Text [2].	

Module	Unit	Contents	Hrs
III		**The fundamental theorem of arithmetic**	**12**
	3	Mathematical induction, binomial theorem, The division algorithm, the greatest common divisor, the Euclidean algorithm, The fundamental theorem of arithmetic. Chapter 1:Sections 1.1, 1.2, Chapter 2:Sections 2.2, 2.3, 2.4, Chapter 3: Section 3.1 of Text [1]) (Exclude all proof).	
IV		**Congruences**	**12**
	4	Basic properties of congruences, binary and decimal representation of integers, Fermat's theorem, Wilson's Theorem (Avoid proofs of theorems). The sum and number of divisors. Chapter 4: Sections 4.2, 4.3, Chapter 5:Sections 5.2, 5.3, Chapter 6 : Section 6.1 of Text [1]).	
V		**Suggestions for teacher designed module**	**12**
	5	Basic concepts and notations, Ordered pairs and Cartesian product, Principle of Duality, Proof of Euclidean algorithm, Proof of Fermat's theorem and Wilson's Theorem. Chapter 5 of Text [2], Chapter 2 : Section 2.4, Chapter 5 : Sections 5.2, 5.3.	

Textbooks

1. David M. Burton, *Elementary Number Theory*, 7th Edition, McGraw Hill, 2011.
2. T. Veerarajan, *Discrete Matematics with Graph Theory and Combinatorics*, Tata McGraw Hill, 2007.

References

1. G A Jones, J M Jones, *Elementary Number Theory*, Springer, 1998.
2. C L Liu, D P Mohapatra, *Elements of Discrete Mathematics, A Computer oriented approach*, Tata McGraw-Hill, 2008.
3. Rajendra Akerkar, Rupali Akerkar, *Discrete Mathematics*, Perason Education, 2007.
4. R M Somasundaram, *Discrete Mathematical Structures*, Prentice Hall of India, 2003.
5. Thomas Koshy, *Elementary Number Theory with Applications*, 2nd Edition, Academic Press, 2007.

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Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand the concept of set theory	PSO 1, PO2, 6	R, U	F,C	L	
CO 2	Analyze real world problems	PSO 1, 2, PO1, 2, 3, 4, 5, 6	Ap, An	P	L	
CO 3	Examine integrated approach to number theory	PSO 1, 3, PO1, 2, 6	U	F, C	L	
CO 4	Apply the concept of congruences	PSO 2, 3, 4, PO1, 2, 5, 6	Ap, An	P	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	-	-	-	-	-	-	1	-	-	-	1	-	-
CO2	2	2	-	-	-	-	2	2	1	1	2	1	-	-
CO3	3	-	2	-	-	-	1	1	-	-	-	1	-	-
CO4	-	2	3	2	-	-	1	2	-	-	1	1	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓			✓
CO2	✓	✓		✓
CO3	✓			✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1DSCMAT108				
Course Title	Differential Calculus				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	3	-	2	5
Pre-requisites	Functions				
Course Summary	Brief review of calculus, Polynomial and elementary transcendental functions and their applications, derivatives, extremum problems, curve-sketching, approximations, Use of symbolic manipulation and graphics software in calculus.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Introduction to derivatives**		**9**
	1	The derivative of a function, Algebra of derivatives – derivatrives of sum, product, quotient, Sections 2.2, 2.3, 2.4 of Text[1] (Proofs of theorems excluded)	
II	**Chain rule**		**9**
	2	The chain rule. Implicit differentiation. Sections 2.6, 2.7 of Text[1]	
III	**Special derivatives**		**9**
	3	Derivatives of logarithmic, exponential and inverse functions, L'Hopital rule. Sections 6.1, 6.2, 6.3, 6.5 of Text[1] (Integrals involving logarithmic, exponenial and inverse functions are excluded)	

Module	Unit	Contents	Hrs
IV	**Analysis of functions using derivatives**		**9**
	4	Increasing, decreasing and concavity, extremum problems, absolute maxima and minima, Sections 3.1, 3.2, 3.4 of Text[1]	
V	**Topics suggested for the teacher designed module**		**9**
	5	Families of functions, inverse functions, Exponential and logarithmic functions, related rates and local linear approximation, graphing polynomials, Rolle's theorem, Mean-value theorem	

Note : In all these topics above, proofs of theorems are to be excluded.

Practical sessions – 30 hours

All the topics (including those in the suggestions for the teacher designed module) can be used for practical sessions.

Problems for the practical examination

1. Demonstrate the basic arithmetic operations (`+, -, *, ^, /`)
2. Demonstrate how to use the standard trigonometric, log, exponential functions, and how to evaluate them at given real numbers
3. Define polynomials of various order, evaluate them
4. Define functions, and evaluate two-sided limits
5. Define functions, and evaluate one-sided limits
6. Demonstrate the plot command with various options (line style, color, thickness etc)
7. Define functions, find their derivatives of different orders
8. Solving polynomial equations and equations involving standard functions
9. Sketching graphs of curves using plot with various styling options (thickness, line style, color etc)
10. Finding maxima, minima using first and second derivative tests.
11. Finding points of inflection and sketching them

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, from the list of above 10 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

Textbooks

1. H Anton, I Bivens, S Davis, *Calculus*, 10th Edition, John Wiley & Sons, 2012.

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References

1. Joel Hass, Maurice D. Weir, *Thomas' Calculus Early Transcendentals*, 12th Edition, Addison-Weseley Publishing Company, 2004.

2. J Stewart, *Calculus with Early Transcendental Functions*, 7th Edition, Cengage India Private Limited, 2004.

3. G B Thomas, R L Finney, *Calculus*, 9th Edition, Addison-Weseley Publishing Company, 2004.

Resources for practical sessions

P1. Sagemath documentation – Introductory Sage Tutorial https://doc.sagemath.org/html/en/prep/Intro-Tutorial.html

P2. Saskia Roos, Michael Jung, *An Introductory Course on Sage, Lecture Notes* https://www.math.uni-potsdam.de/fileadmin/user_upload/An_Introductory_Course_on_Sage.pdf

P3. Sagemath documentation – Symbolic variables https://doc.sagemath.org/html/en/reference/calculus/sage/calculus/var.html

P4. Tuan A. Le, Hieu D. Nguyen, SageMath Advice for calculus https://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf

P5. P. Zimmermann *et al*, Computational Mathematics with SageMath, https://www.sagemath.org/sagebook/english.html

P6. Gregory V. Bard, Sage for Undergraduates http://www.people.vcu.edu/~clarson/bard-sage-for-undergraduates-2014.pdf

Course Outcomes

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CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Assignment (As)
CO 1	Understand the basic concept of functions, limit, continuity and derivatives	PSO1,2, PO1	U	F,C	L,T	
CO 2	Analyse the properties of functions using derivatives	PSO2, PO3, 4	An	F	L,T	
CO 3	Apply deferentiation techniques to solve various problems	PSO1,3, PO2, 3	U,An	C	L,T	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	1					3							
CO2		2							1	3				
CO3	2		3					2	2					

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		
CO4	✓	✓		✓

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University of Kerala

Descipline	Mathematics				
Cours Code	UK1DSCMAT109				
Course Title	Mathematics for Social Sciences - I				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	4	-	-	4
Pre-requisites	Matrices				
Course Summary	This is a brief introductory course on matrices, system of linear equations and LPP				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Matrices**	**12**
	1	Ordered pairs, Cartesian products, Relations	
	2	Functional Relations and Functions	
	Chapter 1: Sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.14, 1.15,1.16, 1.17 of Text [1]		
II		**Linear Equations**	**12**
	3	Equations and identities -Linear and quadratic equations	
	4	Solution of equations, Solutions of quadratic equations, Solution of simultaneous equations	
	Chapter 3: Section 3.1 of Text [1].		
III		**Linear Programming**	**12**
	5	Introduction, Basic assumptions, The general linear Programming Problem (For two variables only)	

Module	Unit	Contents	Hrs
	6	Feasible and basic feasible solutions, multiple optimal solutions, Problems with no feasible solution (simple problems only)l Geometry of Linear Programming Problem (Graphical Solution)	
	18: Section 18.1, 18.2, 18.4, 18.5 of Text [1]		
IV	**Functions and Curves**		**12**
	7	Demand functions and curves	
	8	Total Revenue curve, Cost Curves.	
	Chapter 4: Appendix of Text [1]		
V	**Suggestions for teacher designed module**		**12**
	For internal assessment examinations only.		
	9	Properties of Sets; Three or more sets: Venn Diagram Applications of Linear Equations Concept of degeneracy in an LPP Production functions, Marginal Product Curves	
	These topics can be found on Chapters 1: Section 1.9, 1.10; Chapter 3: Section 3.1; Chapter 18: Section 18.6; Chapter 4: Appendix of Text [1]		

Textbook

1. B.C. Mehta, G.M.K. Madnani, Mathematics for Economics. Sultan Chand & Sons, 1976.

References

1. Agarwal B.M, Business Mathematics and Statistics, Vikas Publishing House,New Delhi, 2009.
2. Allen, R.G.D., Mathematical Analysis for Economists, New Delhi: AITBS Publishers, 2008.
3. Yamane, Taro, Mathematics for Economists: An Elementary Survey. New Delhi: Prentice Hall of India, 2012.

Course Outcomes

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CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Assignment (As)
CO 1	Understand the concepts of sets, ordered pairs, relations and functions	PSO1, PO1, 2, 3, 4, 7	R, U	F,C	L	
CO 2	Solve linear and quadratic equations	PSO3, PO1, 2, 3, 6, 7, 8	U	P	L	
CO 3	Analyze and interpret solutions of linear programming problems using graphical method	PSO4, PO1, 2, 3, 4, 5, 6, 7, 8	An	P	L	
CO 4	Create Diagrams to represent Demand Functions, Total Revenue and Cost Functions	PSO5, PO1, 2, 3, 4, 5, 6, 7, 8	An	C	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	-	-	-	-	-	2	3	1	3	-	-	1	
CO2	-	-	3	-	-	-	2	3	2	-	-	1	3	2
CO3	-	-	-	-	3	-	3	2	1	2	2	2	3	1

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam

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- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1		✓		✓
CO2		✓		✓
CO3	✓			✓
CO4	✓			✓

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University of Kerala

Descipline	Mathematics				
Cours Code	UK1DSCMAT110				
Course Title	Matrices and Linear Equations				
Type of Course	DSC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical	Total Hours per week
	4	4	-	-	4
Pre-requisites	Matrices				
Course Summary	This is a brief introductory course on matrices and system of linear equations				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Matrices**	**12**
	1	Introduction to System of Linear equations, (Matrices and Matrix Operations, Inverses; Algebraic Properties of Matrices- review only). Elementary matrices and method for finding inverse, more on linear systems and invertible matrices, diagonal, triangular and symmetric matrices – Proofs of theorems in this module need not be discussed.	
	Chapter 1: Section 1.1, 1.3 to 1.7 of the Text[1]		
II		**Determinanats**	**12**
	2	Determinants by cofactor expansion, evaluating determinants by row reduction, properties of determinants, Cramer's rule – all these problems in 2×2 matrix case only – Proofs of theorems in this module need not be discussed..	

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Module	Unit	Contents	Hrs
	Chapter 2: Sections 2.1, 2.2 and 2.3 of Text [1]		
III	**Systems of linear equations**		**12**
	3	Linear Systems of Equations, Gauss Elimination, Linear Independence, Rank of a Matrix.	
	4	Solutions of Linear Systems: Existence, Uniqueness– Proofs of theorems in this module need not be discussed.	
	Chapter 7: Sections 7.2, 7.4 (avoid vector space), 7.5 omit proofs of theorems of Text [2]		
IV	**Eigen values and Eigen vectors**		**12**
	5	The Matrix Eigenvalue Problem. Determining Eigenvalues and Eigenvectors)	
	6	Symmetric, Skew-Symmetric, and Orthogonal Matrices	
	7	Diagonalization – all these problems in this module in 2×2 matrix case only– Proofs of theorems in this module need not be discussed.	
	Chapter 8 Section 8.1, 8.4 except eigen bases of Text [2]		
V	**Suggestions for teacher designed module**		**12**
	For internal assessment examinations only.		
	8	Matrix transformations Orthogonality Cramer's rule Diagonalization of 3×3 matrices. Geometry of linear systems Orthogonal Matrices Quadratic Forms	
	These topics can be found on Chapters 1 and 3 of Text [1] and Chapter 8 of Text [2]		

Textbook

1. H Anton, C Rorres. Elementary linear algebra, 11th Edition, John Wiley & Sons, 2013

2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Publishers, 10th Edition, 2018.

References

1. David Poole, Linear Algebra, a modern introduction, Brooks/Cole Cengage learning, 2005.

2. Lee W.Johnson, R. Deanriess, Jimmy Arnold, Introduction to Linear Algebra, Fifth edition, Addison Wisely, 2019.

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Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Assignment (As)
CO 1	Understands system of linear equations	PSO1,2, PO1	U	F,C	L,T	
CO 2	Perform various operations on matrices and determinants	PSO2, PO3, 4	An	F	L,T	
CO 3	Understand the concept of vectors in Euclidean spaces	PSO1,3, PO2, 3	U,An	C	L,T	
CO 4	Apply matrices to soleve system of linear equations	PSO1,3	Ap	C	L,T	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	1					3							
CO2		2							1	3				
CO3	2		3					2	2					

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1		✓		✓
CO2		✓		✓
CO3	✓			✓
CO4	✓			✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1MDCMAT100				
Course Title	Numerical Ability - I				
Type of Course	MDC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	3	3			3
Pre-requisites	Basic Mathematical Operations				
Course Summary	This course is primarily meant for students who have not undergone a Mathematics course beyond their secondary school. The course is expected to improve the student's basic mathematical skills and to understand the mathematics used in their respective fields better.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**HCF, LCM, Percentage**	**10**
	1	Highest Common Factor, Methods of finding HCF, Least Common Multiple, Methods of finding LCM, Problems involving HCF and LCM. *(Chapter 2 of Text [1])*	
	2	Percentage, Problems involving percentage. *(Chapter 5 of Text [1])*	
II		**Average, Ratio and Proportion**	**10**
	3	Average, Problems involving average. *(Chapter 6 of Text [1])*	
	4	Ratio, Types of Ratios, Proportion, Problems involving Ratio and Proportion. *(Chapter 7 of Text [1])*	
III		**Profit and loss,Time, Work and Wages**	**9**

Module	Unit	Contents	Hrs
	5	Profit and Loss, Problems involving profit and loss. *(Chapter 9 of Text [1])*	
	6	Problems involving Time, Work and Wages. *(Chapter 10 of Text [1])*	
IV	**Time and Distance, Boats and Streams**		**10**
	7	Problems involving Time and Distance. *(Chapter 12 of Text [1])*	
	8	Problems involving Boats and Streams. *(Chapter 13 of Text [1])*	
V	**Suggestions for the teacher designed module**		**6**
	9	Partnership, Problems involving partnership. *(Chapter 8 of Text [1])*	
	10	Problems involving Pipes and Cisterns. *(Chapter 11 of Text [1])*	

Textbook

1. Dinesh Khattar, *Quantitative Aptitude for Competitive Examinations*, Fourth Edition, Pearson, 2016

References

1. H Kruglak, JT Moore, RA Mata-Toledo, *Schaum's outline of theorey and problems of Basic Mathematics, with Applications to Science and Technology*, Second Edition, McGraw-Hill, 1998.

2. Rajesh Verma, *Fast Track Objective Arithmetic*, Arihant, 2018.

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Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand basic level mathematics used in real life situations	PSO1, PSO2, PSO3, PO1, PO2, PO5	U, An, E	C, P	L	
CO 2	Do maths problems quickly using ready to use formulae	PSO3, PO2	R, Ap	P	L	
CO 3	Understand the concepts of Ratio and Percentage	PSO1, PO1, PO2, PO5	U, E	P	L	
CO 4	Understand the concepts of direct proportion and inverse proportion	PSO1, PO1	U, E	P	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	3	-	-	-	2	1	-	-	1	-	-	-
CO2	-	-	3	-	-	-	-	1	-	-	-	-	-	-
CO3	2	-	-	-	-	-	2	1	-	-	1	-	-	-
CO4	2	-	-	-	-	-	2	-	-	-	-	-	-	-

(- -Nil, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam

- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		
CO2	✓			✓
CO3	✓	✓		✓
CO4	✓	✓		✓

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University of Kerala

Discipline	Mathematics				
Course Code	UK1MDCMAT101				
Course Title	Mathematical Thinking				
Type of Course	MDC				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	3	3 Hours	-	-	3
Pre-requisites	1. A good basic School Mathematics				
Course Summary	This course is an introduction to the foundations of logic, proof, Divisibility and Linear Diophantine Equations				

Detailed Syllabus

Module	Unit	Contents	Hrs
I		**Foundations of Logic and Proof**	**9**
	1	Logical connectives, Quantifiers. Basic set operations, Relations and Functions. (Chapter 1: Sections 1, 2, 3 of in Text[2], Chapter 2:Sections 1, 2, 3 of in Text [2])	
II		**Divisibility of integers**	**9**
	2	Divisibility, Euclid's Theorem, The Sieve of Eratosthenes, The Division Algorithm, The Greatest Common Divisor, The Euclidean Algorithm, (Chapter: Section 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 of Text [1])	
III		**The Greatest Common Divisor**	**9**
	3	The Greatest Common Divisor, The Euclidean Algorithm, (Chapter: Section 1.7, 1.8, 1.9 of Text [1])	

Module	Unit	Contents	Hrs
IV	**Diophantine equations and the Fundamental Theorem of Arithmetic**		**9**
	4	Diophantine equations, The Postage Stamp Problem. The Fundamental Theorem of Arithmetic, (Chapter 2: Sections 2.1, 2.2, Chapter 3: Sections 3.1, 3.2 of Text [1])	
V	**Suggestions for teacher designed topics**		**9**
	5	Techniques of proof, Chapter 1: Section 3 of in Text[2]	
	6	Number in other bases, Fermat and Mersenne Numbers, Euclid and the Fundamental Theorem of Arithmetic. (Chapter: Section 1.9, 1.10, Chapter 3: Section 3.3 of Text [1])	

Textbooks

1. James S.Kraft, Lawrence C. Washington. *Elementary Number Theory*, CRC Press, 2014.
2. S R Lay. *Analysis with an Introduction to Proof*, 5th Edition, Pearson Education, 2015.

References

1. J P D'Angelo, D B West. Mathematical Thinking- Problem Solving and Proofs 2nd Edition, Prentice Hall, 2018.
2. Daniel J Velleman. How to Prove it : A Structured Approach, 2nd Edition, Cambridge University Press, 2006
3. Elena Nardi, Paola lannonne. How to Prove it : A brief guide for teaching Proof to Year 1 mathematics undergraduates, University of East Anglia, Centre for Applied Research in Education, 2006.
4. Thomas Koshy, Elementary Number Theory with Applications, 2nd Edition, Academic Press, 2007.

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Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand the fundamental concepts of Differentiation	PSO1, 2	U	F,C	L	
CO 2	Explore Differentiation techniques to functions involving vectors and matrices	PSO 2,4	An, C	C, M	L	
CO 3	Develop problem-solving skills through the application of differentiation concepts and systems of linear equations	PSO 2,3	An, C	P, M	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	2	2	3	3	3	-	1	-	-	2	1	1
CO2	1	3	1	2	1	1	1	1	3	-	-	2	1	1
CO3	1	3	2	3	2	3	1	3	3	-	-	3	1	1

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- End Semester Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	—-	—-	✓
CO2	✓	✓	✓	✓
CO3	✓	✓	✓	✓

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