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

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

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)

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	✓	✓		✓