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.

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

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