



University of Kerala

Discipline	Mathematics				
Course Code	UK3DSCMAT213				
Course Title	Applied Linear Algebra and Integral Calculus with Computational Tools				
Type of Course	DSC				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3	-	2	5
Pre-requisites	1. Matrices and determinatnt 2. Integration 3. Linear equations				
Course Summary	This course enable the students to gain an understanding of various applications of linear algebra and integration				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	Euclidean Vector Spaces		9
	1	Vectors in 2-space, 3-space and n -space, Norm, dot product and distance in \mathbb{R}^n , Orthogonality. Sessions 3.1, 3.2, 3.3 of text 1	
	2	The geometry of linear systems, Cross product Sessions 3.4, 3.5 of text 1	
II	Real vector spaces and bases		9
	3	Real vector spaces, subspaces, linear independence Sessions 4.1, 4.2, 4.3 of text 1	
	4	Coordinate and basis, Dimension, Change of basis Sessions 4.4, 4.5, 4.6 of text 1	
III	Matrix spaces and diagonalization		9
	5	Row space, column space, Null space, Rank, Nullity, and the Fundamental Matrix Spaces. Sessions 4.7, 4.8 of text 1	



Module	Unit	Contents	Hrs
	6	Eigenvalues and Eigenvectors, Diagonalization. Sessions 5.1, 5.2 of text 1	
IV	Applications of Integration		9
	7	Area between two curves. Session 5.1 of text 2	
	8	Volumes by slicing; disks and washers. Session 5.2 of text 2	
	9	Length of a plane curve, Area of surface of revolution. Session 5.4, 5.5 of text 2	
V	Suggestions for teacher designed topics		9
	10	Basic Matrix Transformations in \mathbb{R}^2 and \mathbb{R}^3 , Properties of Matrix Transformations, Geometry of Matrix Operators on \mathbb{R}^2	
	11	Volumes by cylindrical shells, Work, Moments, Centers of Gravity and Centroids	

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 in the references.

1. Plot vectors using plot and plot3d
2. Compute norms and distances
3. Verify orthogonality using the dot product
4. Solving the system of equations and visualizing the solution
5. Compute and plot cross products
6. Compute coordinates in different basis
7. Compute and visualize row/column/null spaces
8. Compute eigenvalues/vectors and diagonalize matrices
9. Plot two functions and find the area of the region enclosed by the curves
10. Visualize the solids of revolution, surface of revolution
11. Estimate the volume of the solid that results when the region enclosed by the curves is revolved about the stated axis.
12. Approximate the area of the surface generated by revolving the curve about the stated axis.
13. Parametrize a curve and use arc length formula

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 problems, the student should be able to answer two selected (from the 7 available in the record) by the examiner.

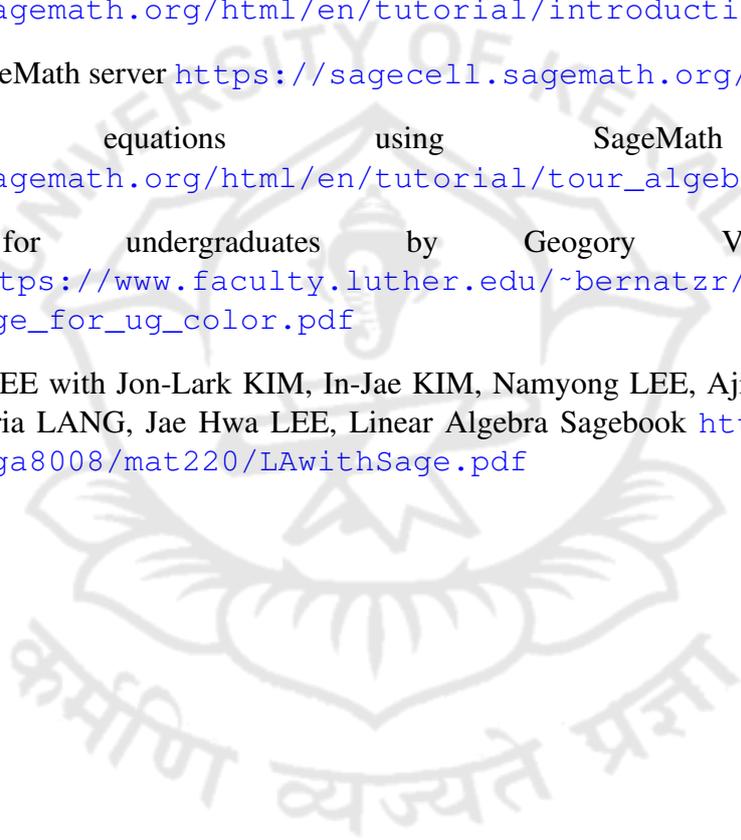


Textbook

1. Elementary linear algebra–application version by *Howard Anton, Chris Rorres*, 11th Edition
2. Calculus by *Howard Anton, Irl Bivens, Stephen Davis*, 10th Edition

References

1. James Stewart–Calculus: Early transcendentals
2. George B.Thomas–Thomas’s Calculus
3. Gilbert Strang–Introduction to Linear algebra
4. David C.Lay–Linear algebra and its applications
5. SageMath – documentation
<https://doc.sagemath.org/html/en/tutorial/introduction.html>
6. Online SageMath server <https://sagecell.sagemath.org/>
7. Solving equations using SageMath https://doc.sagemath.org/html/en/tutorial/tour_algebra.html
8. Sage for undergraduates by Geogory V.Bard (online version)https://www.faculty.luther.edu/~bernatzr/Courses/M351/sage_for_ug_color.pdf
9. Sang-Gu LEE with Jon-Lark KIM, In-Jae KIM, Namyong LEE, Ajit KUMAR, Phong VU, Victoria LANG, Jae Hwa LEE, Linear Algebra Sagebook <https://omega0.xyz/omega8008/mat220/LAwithSage.pdf>



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 and apply vector operations, basic geometry of R^n	PO2, PSO1, 2,3	U, Ap	F,C	L	P
CO 2	Analyze real vector spaces, subspaces, linear independence, and perform basis transformations	PO1, PSO1, 2,3	An, Ap	F,C,P	L	P
CO 3	Compute and interpret the row space, column space, null space, rank, and eigen structures of matrices	PO2, PSO1, 2,3	An, Ap	F,C	L	P
CO 4	Apply integration techniques to compute area, volume and arc lengths	PO2, PSO1, 2,3	E, Ap	C, P	L	P
CO5	Use SageMath effectively to model, visualize and solve linear algebra and calculus problems	PO2, PSO1	Ap, C	P		P

(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	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	3	-	-	-	-	-	-



(- -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	✓	✓		✓

