Lahore University of Management Sciences
MATH 120 – Linear Algebra with Differential Equations
Fall 2013-14
BS (Hons)

Instructor	Faqir M Bhatti and M. Saqib Khan
Room No.	9-251A, Room will be announced later for M. Saqib.
Office Hours	TBA
Email	fmbhatti@lums.edu.pk,
Telephone	042-35608013/ or ext 8013
TA	TBA
TA Office Hours	TBA
Course URL (if any)	http://math.lums.edu.pk/moodle or http://lms.lums.edu.pk

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75min
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution			
Core			
Elective			
Open for Student Category	All students		
Close for Student Category	None		

COURSE DESCRIPTION
This is the first course of a two semester sequence in linear algebra. This course gives a working knowledge of: systems of linear equations, matrix algebra, determinants, eigenvectors and eigenvalues, finite-dimensional vector spaces, matrix representations of linear transformations, matrix diagonalization, changes of basis, Separable and first-order linear equations with applications, 2nd order linear equations with constant coefficients, method of undetermined coefficients, Systems of linear ODE's with constant coefficients, Solution by eigenvalue/eigenvectors, Nonhomogeneous linear systems.

COURSE Anti-PREREQUISITE(S)
• Math in A-levels, FSc, or the equivalent

COURSE OBJECTIVES
• To acquire a good understanding of the concepts and methods of linear algebra • To develop the ability to solve problems using the techniques of linear algebra • To develop critical reasoning by writing short proofs based on the axiomatic method To compute the solution of first order and higher order Ordinary differential equations To solve system of linear ODEs using eigen values and eigen vectors

Learning Outcomes
Students will learn to • Set up and solve systems of linear equations • Perform matrix operations as appropriate • Evaluate determinants and use their properties Understand and use linear transformations Work in real vector spaces

	Use the concepts of subspace, basis, dimension, row space, column space, row rank, column rank, and nullity Use inner products
	Use and construct orthonormal
	bases Perform QR decompositions
	Apply linear algebra for best approximation and least squares fitting
	Evaluate and apply eigenvectors and eigenvalues
	Understand the features of general linear transformations such as kernel, range, inverses, matrix representations, similarity, and isomorphism
	Solve first and higher order ODEs
	Solve system of linear ODEs using eigen values and eigen vectors
	Use Mathematica and Maple to solve ODEs and system of ODEs

Grading Breakup and Policy

Attendance: 5%
Home Work(3): 10%
Quizzes: (4) : 15%
Webwork(4): 15%
Midterm Examination: 25
Final Examination: 30

Examination Detail

Midterm Exam	Yes/No: Yes Combine/Separate: Duration: 90min Preferred Date6 Mar 2013 Exam Specifications: No notes/No books/No calculators
Final Exam	Yes/No: Yes Combine : Duration: 180min Exam Specifications: No notes/No books/No calculators

COURSE OVERVIEW

Week/ Lecture/ Module	Topics	Recommended Readings	Objectives/ Application
Part (i)	**Systems of linear equations**	**Chapter 1**	**Systems of linear equations and matrices**
•	Gaussian elimination	**Chapter 1 Section 1.1 1.2**	**Systems of linear equations and matrices**
•	Matrices and matrix operations	**Chapter 1 Section 1.3**	**Systems of linear equations and matrices**
•	Matrix arithmetic	**Chapter 1 Section 1.4**	**Systems of linear equations and matrices**
•	Inverses	**Chapter 1 Section 1.4**	**Systems of linear equations and matrices**
•	Elementary matrices and inverses	**Chapter 1 Section 1.5**	**Systems of linear equations and matrices**
•	Further results on systems of linear equations and inverses	**Chapter 1 Section 1.6**	**Systems of linear equations and matrices**
•	Diagonal, Triagonal, and symmetric matrices	**Chapter 1 Section 1.7**	**Systems of linear equations and matrices**
•	**Determinants**	**Chapter 2**	**Determinants**
•	Cofactor expansion	**Section 2.1 and 2.2**	**Determinants**

		Section 2.3	Determinants
•	Properties of determinants	Section 2.3	Determinants
	Euclidean vector spaces	**Chapter 4**	**Euclidean vector spaces**
•	Euclidean n-space	**Section 4.1**	**Euclidean vector spaces**
•	Linear transformations from R^m to R^n	**Section 4.2 and 4.3**	**Euclidean vector spaces**
•	Linear transformations and polynomials	**Section 4.4**	**Euclidean vector spaces**
•	General Vector Space	**Chapter 5**	
•	Real vector spaces	**Section 5.1**	**Vector spaces**
•	Subspaces	**Section 5.2**	**Vector spaces**
•	Basis and dimension	**Section 5.4**	**Vector spaces**
•	Row space, column space, null space	**Section 5.5**	**Vector spaces**
•	Rank and nullity	**Section 5.6**	**Vector spaces**
•	Inner Product Spaces	**Chapter 6**	
•	Inner product spaces	**Section 6.1**	**Inner product spaces**
•	Angle and orthogonality	**Section 6.2**	**Inner product spaces**
•	Orthonormal basis	**Section 6.3**	**Inner product spaces**
•	Gram-Schmidt process	**Section 6.3**	**Inner product spaces**
•	Change of basis	**Section 6.5**	**Inner product spaces**
•	Orthogonal matrices	**Section 6.6**	**Inner product spaces**
•	Eigenvalues and eigenvectors	**Chapter 7**	
•	Eigenvalues and eigenvectors	**Section 7.1**	**Eignvalues and eigenvectors**
•	Diago nalization	**Section 7.2**	**Eigenvalues and eigenvectors**
•	Orthogonal diagonalization	**Section 7.3**	**Eigenvalues and eigenvectors**
Part (ii)	**Ordinary differential equations**		**Differential equations with boundary value problems by Dennis G Zill**
	Introduction to differential equations	**Chapter 1**	
	Basic definitions and terminology	**Sections 1.1, 1.2**	
	First order differential equations	**Chapter 2**	
•	Separable and first-order linear equations with applications,	**Section 2.1, 2.2, 2.3**	**First order differential equations**
•	Differential equations of higher order	**Chapter 4**	
•	Homogeneoue equations, Nonhomogeneous equation	**Section 4.1, 4.2**	**Differential equations of higher order**
•	Higher order linear equations with constant coefficients	**Section 4.3**	**Differential equations of higher order**
•	Systems of linear first order differential equations	**Chapter 8**	
•	Homogeneous linear systems with constant coefficients	**Section 8.1, 8.2**	**Systems of linear first order differential equations**
•	Solution by eigenvalue/eigenvectors, nonhomogenous linear systems	**Section 8.2, 8.3**	**Systems of linear first order differential equations**

Textbook(s)/Supplementary Readings

There is no required text but the following texts will be used for reference.

1. Elementary linear algebra (2005) Howard Anton, 9th edition, John Wiley and Sons
2. Differential equations with boundary-value problems by Dennis G. Zill and Michael R. Cullin (5th Edition Brooks/Cole)

Handouts on topics will also been uploaded on the LUMS website

Helping Software's :
Mathematica

Lahore University of Management Sciences

A first course in linear algebra, RA Beezer, http://linear.ups.edu/