GENERAL GUIDE LINES FOR MATH. 111 – LINEAR ALGEBRA
SPRING SEMESTER 2017-2018

COURSE NUMBER	**:**	**Math 111 (04 10 111)**
COURSE NAME	**:**	**Introductory Linear Algebra**
PREREQUISITE	**:**	**Math 91**
CREDITS	**:**	**3**
TEXT BOOK	**:**	**Elementary Linear Algebra with Supplemental Applications (Eleventh Edition) by Howard Anton & Chris Rorres**

Catalogue Description

Matrices: solving systems of linear equations, matrix operations, inverse of a matrix.
***Determinants*:** definitions and properties, cofactor expansion and applications.
Vectors in $\mathbb{R}^n$**:** scalar and cross products, lines and planes, geometric applications.
***Vector Space*:** subspaces, linear independence, bases and dimensions for vector space, row space, column space and null space of a matrix, Rank of a matrix.
***Eigenvalues & Eigenvectors of a matrix*:** similar matrices, diagonalization of a matrix.

About the Book

- The exercises in this course are grouped into two classes: ***Routine Exercises*** and ***Theoretical Exercises.***
- At the end of each chapter, a summary of ***Key Ideas for Review***, a set of ***Supplementary Exercises*** and a ***Chapter Test*** are given.

Course Syllabus

Chapter 1. Systems of Linear Equations and Matrices: Matrices and their properties. Methods of solving systems of linear equations. Homogenous system of linear equations. Inverse of a matrix.
Chapter 2. Determinants: Basic properties of determinants. Cofactors expansion.
Chapter 3. Euclidean Vector Spaces: Vectors in $\mathbb{R}^n$. Geometric ideas dealing with vectors in $\mathbb{R}^3$. Some applications of cross product. Equations of lines and planes
Chapter 4. General Vector Spaces: The notion of a vector space, Subspaces, Linear independence of vectors. Basis and dimension of a vector space. Bases for row space, column space and null space of a matrix. Rank of a matrix.
Chapter 5. Eigenvalues and Eigenvectors: Eigenvalues and eigenvectors of a matrix. Similar matrices. Diagonalization of a matrix.

For more details see:

http://math.sci.kuniv.edu.kw (***Solutions Manual (Anton Book)*** , Undergraduates, Past Exams, Common Courses, ***Theoretical Exercises (Kolman Book)***, Revision, Exercises…, etc).

TENTATIVE TIME TABLE FOR LECTURES
SPRING SEMESTER 2017/2018 (Eleventh Edition)

Week	*Sections*	*Materials to be Covered*
28/01 - 01/02	**1.1, 1.2**	*1.1 (Briefly Linear Systems in 2 and 3 unknowns pages 3-6), and in 1.2 omit (Round off Error and Instability).*
04/02 - 08/02	**1.2, 1.3**	*All 1.3.*
11/02 - 15/02	**1.4**	*All 1.4.*
18/02 - 22/02	**1.5, 1.6**	*In 1.5 omit (def. 2 page 42 – page 44, part (d) Theorem 1.5.3, A Method for Inverting Matrices and Inversion Algorithm). All 1.6.*
25/02 - 01/03	**1.7, 2.1**	*All 1.7.* ***Permutations & determinant of an $n \times n$ matrix****. All 2.1.*
First Mid-term Exam Wednesday 07/03/2018 (12:30 pm – 1:45 pm)		
04/03 - 08/03	**2.1, 2.2**	*In 2.2 (Omit Theorem 2.2.4, Example 1).*
11/03 - 15/03	**2.3, 3.1**	*In 2.3 (Optional Lemma 2.3.2 and Cramer's Rule). Properties of determinants. In 3.1 Operations on Vectors in $\mathbb{R}^n$ (page 122 - 125), omit Application of linear Combinations to Color Models.*
18/03 - 22/03	**3.2, 4.1**	*In 3.2 Defs. 1,2*,3,4(Optional pages130,131) (correct def. 2: are vectors in $\mathbb{R}^n$). All 4.1(Optional Examples 3,4,5,6).*
25/03 - 29/03	**4.2, 4.3**	*All 4.2 (Optional Examples 5,6,7,8,9,10,12,13). In 4.3(Optional Examples 4, 5, 8) and (Omit Linear independence of two functions, Linear independence of functions and pages 192, 193).*
01/04 - 05/04	**4.4, 4.5, 4.7**	*In 4.4 Optional (Examples 2, 4, 5, 6 and from Definition 2 page 199 to page 201). In 4.5(Optional Example 5 and proofs in pages 206 – 208). All 4.7.*
Second Mid-term Exam Wednesday 11/04/2018 (12:30 pm – 1:45 pm)		
08/04 - 12/04	**4.7, 4.8**	*All 4.8.*
15/04 - 19/04	**5.1, 5.2, 3.5**	*All 5.1(omit all what is about T_A). All 5.2. In 3.5(Optional proofs of $\|\|U \times V\|\|$, area of triangle and volume of parallelpiped).*
22/04 - 26/04	**3.5, 3.3**	*In 3.3(Optional From Orthogonal Projections in page 140 to 142 and Distance Problems in page 143 to 145). In 3.3 (lines and planes in $\mathbb{R}^3$ only).* ***Give the symmetric form of a line in $\mathbb{R}^3$.***
29/04 - 03/05	**3.4**	*In 3.4 Only Lines and Planes in $\mathbb{R}^3$. (Omit parametric equation and the vector form (equation) of a plane).* [No proofs].
06/05 - 08/05	**3.4**	*Solve Supplementary Problems.*

Final Exam. Tuesday 15/05/2018. (09:00 am - 11:00 am).

PS. **Please, try to follow this tentative time table as possible as you can.**

Examination Schedule & Distribution of Grades

Examination	*Day & Date*	*Time*	Sections to be included	*Grades*
First Midterm	***Wednesday 07/03/2018***	***12:30 pm − 1:45 pm***	***1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7.***	***25 %***
Second Midterm	***Wednesday 11/04/2018***	***12:30 pm − 1:45 pm***	***2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 4.3, 4.4, 4.5.***	***25 %***
Final	***Tuesday 15/05/2018***	***09:00 am −11:00 am***	***All Covered Sections***	***40 %***
Quizzes	*The quizzes take place in the tutorial classes. Each TA is supposed to give* ***7 quizzes*** *and consider the average of the* ***best five scores****.*			***10 %***

LINEAR ALGEBRA-MATH 111

SELECTED PROBLEMS (Eleventh Edition)

§	*Recommended Exercises for Students**	*Exercises for Tutorial (Solved by TA)*	*For Instructor*
1.1	*1, 3, 7, 9, 11, 13.*	*6, 12, 14.*	
1.2	*15, 17, 19, 21, 23, 29, 31, 37, 39, 41, 43, 45, 47, 48, 49, 50, 55.*	*20, 22, 24, 28, 32, 38, 40, 44, 46, 51, 53.*	
1.3	*58, 59, 60, 65, 67, 69, 71, 73, 75, 80, 81(a,c), 83.*	*64, 66(b,c), 68, 70(a), 74, 79, 84, 86.*	*Theorem(1.3.1).*
1.4	*93, 97, 99, 101, 103, 107, 111, 115, 121, 123.*	*90, 100, 102, 109, 112, 116, 118, 122, 124.*	*Theorems(1.4.1(a,j), 1.4.2(e), 1.4.4, 1.4.5, 1.4.6, 1.4.7, 1.4.9), 106, 110, 114, 126, 127.*
1.5	*151(b), 153, 160, 161, 164(a,b).*	*152, 163, 164(c).*	
1.6	*167, 170, 171, 172, 173, 175, 176, 177.*	*165, 169, 174, 179, 180, 181, 182.*	*Theorems(1.6.1, 1.6.2, 1.6.3, 1.6.4 without d),*
1.7	*183, 184, 185, 186, 187, 188, 189, 191, 193, 194, 195, 196, 198, 200, 201, 204, 205, 209, 210(b), 215, 217.*	*190, 192, 206, 207, 208, 210(a), 211, 216, 218.*	*Illustrate Theorem 1.7.1 and prove Theorems (1.7.2, 1.7.3), 212, 213, 214, 220.*
2.1	*1, 3, 5, 6, 9, 10, 11, 15, 17, 19, 21, 22, 24, 26, 27, 31, 35.*	*12, 16, 18, 20, 23, 28, 29, 34, 36.*	
2.2	*37, 39, 41, 44, 47, 48, 51, 52, 54, 55, 56, 58, 59, 65.*	*46, 50, 53, 57, 61, 63, 66.*	
2.3	*67, 70, 71, 72, 73, 76, 80, 81, 84, 85, 88, 103.*	*78, 83, 86, 94, 101, 102.*	*90, 98, 100, 104.*
3.1	*7, 10, 11, 13, 14, 16, 17, 19, 20, 23, 24, 26, 27, 31*	*8(b), 9(b), 12, 22, 30, 34.*	
3.2	*35, 37, 39, 41, 43, 46, 48, 49, 52, 54, 56, 57, 59.*	*36, 44, 45, 47, 61, 62, 63.*	*50, 51, 55, 60.*
4.1	*1, 2, 3, 4, 11, 16.*	*5, 6, 7, 15, 20.*	*19, 21, 22, 23.*
4.2	*24(c,d,e), 28, 30, 31, 32, 34(c,d), 35(b,c), 38(a,b,d,f), 41.*	*24(a,b), 29, 34(a,b), 35(a,d), 38(c,e), 42.*	*Theorems(4.2.1, 4.2.2, 4.2.3(a),4.2.4)*
4.3	*44(a,c,d), 45, 47(a), 48(a,b), 49, 58, 59, 56(b).*	*43(a,b), 44(b), 47(b), 48(c), 50, 51, 55, 56, 57.*	*52, 53.*
4.4	*66(a,b), 67, 68(b,c,d), 82.*	*68(a).*	*Theorem 4.4.1.*
4.5	*84, 87, 88, 89, 90(a,d), 91(a,b), 96, 98, 99.*	*86, 90(b,c), 91(c), 95, 97.*	*Theorem 4.5.1.*
4.7	*129, 130(a,c,d), 131(a,c,d,e), 132, 133(a,c,d), 134(a,c,d,e), 135(a,c,d), 136(a,c,d), 137(a,c,d), 138(b,c), 139(b,c), 141, 143, 145, 146.*	*130(b), 131(b), 133(b), 134(b), 135(b), 136(b), 137(b), 138(a), 139(a), 144(a).*	*Theorem 4.7.1*
4.8	*147, 148(a,b,d,e), 149, 155, 158, 159, 163, 164.*	*148(b), 150, 151, 153, 154.*	*152, 156, 162.*
5.1	*1, 2, 3(a,b,d,f), 4, 5, 6(b,c,d,e,f), 7(b,c,d,e,f), 8(b,c,d,e,f), 9, 10, 11, 12(c), 13, 16(a), 17, 19, 20, 21, 22, 25, 26, 28(a,c).*	*3(c,e), 4(e), 5(e), 6(a), 7(a), 8(a), 12(a,b), 14, 16(b), 18.*	*Theorems(5.1.2, 5.1.3, 5.1.4, 5.1.5) and 23.*
5.2	*31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 57, 58, 62.*	*30, 34, 51.*	*Theorem 5.2.4*
3.5	*139, 140, 141, 145, 150, 151, 155, 156, 157, 158, 160, 161, 163, 165, 166, 167, 169, 170, 171.*	*144, 146, 149, 153, 154, 164, 168, 172.*	*Theorems(3.5.1,3.5.2, 3.5.5)*
3.3	*65, 67, 70, 72, 76, 77, 78, 79, 81, 82, 108, 109, 110.*	*68, 71, 74, 80, 107.*	*Theorem 3.3.3 & 69, 73.*
3.4	*111, 114, 115, 119, 122, 123, 125, 127, 133, 135, 137.*	*117, 118, 120, 121, 128, 131, 132.*	

*All (relevant) True-False questions at the end of each section are required by students.

Remarks

- Solutions Manual of book problems can be accessed at: http://math.sci.kuniv.edu.kw
- Ch 1, Ch 2, Ch 3, Ch 4, Ch 5. [Password: Algebra111].

Teaching Guide Lines

1) The following notations should be used: **Capital letters** *A, B, C,…* **for <u>matrices</u> and <u>vectors</u>**, while small letters *a, b, c, …* for scalars. {X=(1,2,3) is a vector with 3 components and X(1,2,3) is a point of 3 coordinates.}
2) The cofactors of matrices A and B are A_{ij} and B_{ij}.
3) Scalars will be always real numbers.
4) Use the letter *O* for the **zero matrix** (or O_{mxn} for the mxn zero matrix).
5) Elementary matrices are ***optional***.
6) All geometric interpretations are ***optional***.
7) Geometry is only for lines and planes in $\mathbb{R}^3$ to be given in Chapter 3, Sections 3.3, 3.4.
8) Only the point-normal equation of a plane is given. The vector, parametric equations and the **symmetric form** of a line in $\mathbb{R}^3$ are given.
9) Properties of determinants are proved in the general case. [permutations may be used]
10) In Section 2.3 Cramer's rule is excluded.
11) In Section 3.2 Table 1 page 135 give only the first and fourth rows of the table.
12) In Chapter 4, all Definitions and Examples should be in $\mathbb{R}^n$ only.
13) Theorems with equivalent statements: The student should use in his proof the given statements without using other equivalent ones.
14) The proofs of the following items are **<u>optional to teach</u>**, i.e., will not be included in any exam: In such cases <u>student should memorize each item and use it</u>.
    1. The associativity property of matrix multiplication {A(BC)=(AB)C}.
    2. Cauchy-Schwarz's inequality.
    3. $\|X\times Y\|=\|X\|\,\|Y\|\sin\theta$.
    4. Product of two upper (lower) triangular matrices is an upper (lower) triangular matrix. (General case n x n matrices).
    5. Product of two diagonal matrices is a diagonal matrix. . (General case *n* x *n* matrices).
    6. The j^{th} –column of the product of two matrices is a linear combination of the columns of the matrix in the left. In such a case <u>student should memorize the formula</u>.(**Please, prove it, although its proof will not be in exams**).
    7. The i^{th}-row of the matrix product AB is a linear combination of the rows of B. In such a case <u>student should memorize the formula</u>.
    8. det(AB)=det(A) det(B).
15) **All Theoretical exercises, proofs of theorems, lemmas and results other than those mentioned in part 14 may be required from the students to prove in the exams.**

<u>Remarks:</u>

- *If you have any list of past exams or any supplementary problems you want to suggest for your students as revision problems before the exams, please, give it to the course coordinator to assemble a list of problems to be given to all students in all sections or to make it available on the departmental web site, at least two weeks before the exam date.*
- *We should provide the examination committee with problems, with their solutions, for the exam two weeks before the exam.*