DE LA SALLE UNIVERSITY
College of Science
Mathematics and Statistics Department

MTH221A – *Linear Algebra (3 units)*

Prerequisite: MTH202A (Mathematical Analysis 2)
Prerequisite to: MTH253A (Operations Research 1), STT141A (Linear Models), MTH242A (Numerical Analysis), MTH230A (Modern Geometry)

Instructor:_____ **Contact details:**_____
Consultation hours:_____ **Room class schedule:**_____
Class days and time: _____

Course Description

This is an introductory course in linear algebra taken up as a major course by students in the mathematics programs. Topics discussed include matrices, vector spaces, linear transformation and its matrix representations, eigenvalues and eigenvectors, and diagonalization.

Learning Outcomes

On completion of this course, the student is expected to present the following learning outcomes in line with the Expected Lasallian Graduate Attributes (ELGA) and the outcomes prescribed by the CHED Memorandum Order for the BS Mathematics program.

ELGA	Learning Outcome	Program Outcome							
Critical and Creative Thinker Effective Communicator Lifelong Learner	At the end of the course, the student will	1	2	3	4	5	6	7	8
	apply appropriate linear algebraic concepts, thinking processes, tools, and technologies in the solution to various conceptual or real-world problems.	✓	✓	✓	✓	✓	✓	✓	✓

Program Outcomes (BS Mathematics)

A graduate of the program should be able to

1. Apply analytical, critical and problem-solving skills using the scientific method.
2. Carry out basic mathematical and/or statistical computations and use appropriate technologies in the analysis of data, and in pattern recognition, generalization, abstraction, critical analysis, and problem solving.
3. Gain mastery in the core areas of mathematics: algebra, analysis and geometry
4. Demonstrate skills in pattern recognition, generalization, abstraction, critical analysis, problem-solving and rigorous argument.
5. Develop an enhanced perception of the vitality and importance of mathematics in the modern world, including the interrelationships within mathematics and its connection to other disciplines
6. Appreciate the concept and role of proof and reasoning and demonstrate knowledge in reading and writing mathematical proofs.
7. Make and evaluate mathematical conjectures and arguments and validate their own mathematical thinking
8. Communicate mathematical ideas orally and in writing using clear and precise language

Final Course Outputs

As evidence of attaining the above learning outcomes, the student is required to submit the following during the indicated dates of the term.

Learning Outcome	Required Outputs	Due Date
At the end of the course, the student will apply appropriate linear algebraic concepts, thinking processes, tools, and technologies in the solution to various conceptual or real-world problems.	• Carefully crafted compilation of solved problems (theoretical exercises) that will manifest the application of the concepts learned and reflection.	Problems will be given weekly, and students will submit the solutions on the following week. After the solutions are returned, the students will edit these and will write an explanation about how the item should be solved. The compilation of corrected solutions will be submitted at Week 13
	• Construct a concept map to illustrate the inter-relationships among the various concepts and processes studied in the course	Week 13

Rubric for assessment for compilation of solutions to problems

CRITERIA	Excellent (4)	Very Good (3)	Satisfactory (2)	Needs Improvement (1)
Understanding of mathematical concepts	Shows complete understanding of the underlying mathematical concepts and principles needed to solve the problem.	Shows nearly complete understanding of the problem's mathematical concepts and principles.	Shows some understanding of the mathematical concepts and principles needed to solve the problem.	Shows very limited understanding of the problem's mathematical concepts and principles.
Clarity of Explanation	Explanation is well-written, complete and unambiguous.	Explanation is clear but few simple details are missed. Terminologies	Explanation is little difficult to understand. Some symbols and notations are	Explanation is difficult to understand.

	Terminologies and symbols are used correctly.	and symbols are used appropriately.	used inappropriately.	
Understanding of methods of proof	Shows correct understanding of the method of proof. Statements are logical and the desired conclusion is arrived at.	Shows correct understanding of the method of proof. The proof proceeded logically except for a few minor errors.	Shows correct understanding of the method of proof but there are major errors in reasoning.	Lacks understanding of the method of proof but an attempt to solve the problem is evident.

Rubric for assessment of concept map				
CRITERIA	Excellent (4)	Very Good (3)	Satisfactory (2)	Needs Improvement (1)
Understanding of Mathematical Concepts	Shows complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another	Shows an almost complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another.	Shows a moderate degree of under-standing of the concepts and processes studied in the course as well as their inter-relationships with one another.	Shows a limited degree of under-standing of the concepts and processes studied in the course as well as their inter-relationships with one another.
Clarity of Presentation	The ideas presented are easily understood and the existing interrelationships among the concepts and processes are clearly indicated.	Except for a few minor details, the ideas presented are easily under-stood and the existing interrelationships among the concepts and processes are clearly indicated.	Some ideas are not clearly presented, and some inter-relationships are either lacking or not correctly presented,	Many of the ideas presented and inter-relationships among concepts and processes are incorrect or lacking.
Creativity and Completeness	The objects in the concept map are aesthetically organized and includes all the important concepts included in the course.	A few objects in the map are not properly organized and a few concepts were not included.	Some major concepts and processes and their interrelationships are either misplaced or not included	Majority of the concepts, processes and interrelationships are incorrectly placed or described, or are missing from the concept map.

Additional Requirements

- **Quizzes/Seatwork**
- **Homework**
- **Final Exam**

Grading System

	FOR EXEMPTED STUDENTS (w/out Final Exam)	FOR STUDENTS with FINAL EXAM	
		with no missed quiz	*With one missed quiz*
Average of quizzes	90%	60%	55%
Project	10%	10%	10%
Final exam	-	30%	35%

Scale:

95-100%	4.0
89-94%	3.5
83-88%	3.0
78-82%	2.5
72-77%	2.0
66-71%	1.5
60-65%	1.0
<60%	0.0

Learning Plan

LEARNING OUTCOMES	TOPIC	WEEK NO.	LEARNING ACTIVITES
At the end of the course, the student will apply appropriate linear algebraic concepts, thinking processes, tools, and technologies in the solution to various conceptual or real-world problems.	**1. Linear Equations and Matrices** 1.1 Matrices and Matrix Operations 1.2 Algebraic Properties of Matrix Operations 1.3 Special Classes of Matrices 1.4 The Echelon Form of a Matrix 1.5 Equivalent Matrices 1.6 Solutions of Linear Systems 1.7 The Inverse of a Matrix	Weeks 1-3	• Cooperative Learning • Skills exercises • Seatwork • Computer Aided Exercises • Problem Set*
	Q U I Z 1		
	2. Determinants 2.1 Definition and Related Concepts 2.2 Properties of Determinants 2.3 Cofactor Expansion 2.4 Inverse of a Matrix 2.5 Cramer's Rule	Weeks 4-5	• Cooperative Learning • Skills exercises • Seatwork • Problem Set*
	Q U I Z 2- Includes Sections 3.1 and 3.2		
	3. Vector Spaces	Weeks 6-8	• Cooperative Learning • Library work

	3.1 Vector Spaces and Subspaces 3.2 Linear Combinations and Spanning Sets 3.3 Linear Independence 3.4 Bases and Dimension		• Skills exercises • Seatwork • Problem Set*
	4. Linear Transformations 4.1 Definitions and Examples 4.2 Isomorphisms 4.3 Coordinate Vectors 4.4 Matrix of a Linear Transformation	Weeks 9-11	• Library work • Cooperative Learning • Skills exercises • Seatwork • Problem Set*
	QUIZ 3		
	5. Eigenvalues, Eigenvectors and Diagonalization 5.1 Eigenvalues and Eigenvectors 5.2 The Characteristic Polynomial 5.3 Diagonalization 5.4 Inner Product Spaces* 5.5 Diagonalization of Symmetric Matrices*	Weeks 12-13	• Cooperative Learning • Library work • Skills exercises • Seatwork • Problem Set*
FINAL EXAMINATION			

*Problem sets are given weekly and the students are expected to work on the solutions for their fourth hour activity. The returned solutions will be rewritten to include all corrections and reflections.

At the end of the term, the solutions to the problems will be compiled and submitted as one of the course outputs. In the last 2-3 weeks, the students are also expected to on their concept maps.

References

Anton, H. (1981) Elementary Linear Algebra, (2nd edition) N.Y.: Wiley

Fraleigh and Beauregard,(1995). Linear Algebra (3rd Edition). Addison : Wesley

Kolman B. and Hill, D., (2003),*Elementary Linear Algebra, (7th edition)*. Upper Saddle River, NJ: Pearson Education

Lee, Riess and Arnold,(1993). Introduction to Linear Algebra, (3rd edition). Reading Mass: Addison - Wesley

Perry, W. (1988). Elementary Linear Algebra, (4th edition). NY: McGraw Hill

Online Resources

A First Course in Linear Algebra Accessed October 24, 2012 from: http://linear.ups.edu/

Dawkins, P. (2012) *Paul's Online Notes: Linear Algebra*. Accessed October 24, 2012 from: http://tutorial.math.lamar.edu/classes/Linalg/linalg.aspx

Class Policies

1. The required minimum number of quizzes for a 3-unit course is 3, and 4 for 4-unit course. No part of the final exam may be considered as one quiz.
2. Cancellation of the lowest quiz is not allowed even if the number of quizzes exceeds the required minimum number of quizzes.
3. As a general policy, no special or make-up tests for missed exams other than the final examination will be given. However, a faculty member may give special exams for
   A. approved absences (where the student concerned officially represented the University at some function or activity).
   B. absences due to serious illness which require hospitalization, death in the family and other reasons which the faculty member deems meritorious.
4. If a student missed two (2) examinations, then he/she will be required to take a make up for the second missed examination.
5. If the student has no valid reason for missing an exam (for example, the student was not prepared to take the exam) then the student receives 0% for the missed quiz.
6. Students who get at least 89% in every quiz are exempted from taking the final examination. Their final grade will be based on the average of their quizzes and other prefinal course requirements. The final grade of exempted students who opt to take the final examination will be based on the prescribed computation of final grades inclusive of a final examination. Students who missed and/or took any special/make-up quiz will not be eligible for exemption.
7. Learning outputs are required and not optional to pass the course.
8. Mobile phones and other forms of communication devices should be on silent mode or turned off during class.
9. Students are expected to be attentive and exhibit the behavior of a mature and responsible individual during class. They are also expected to come to class on time and prepared.
10. Sleeping, bringing in food and drinks, and wearing a cap and sunglasses in class are not allowed.
11. Students who wish to go to the washroom must politely ask permission and, if given such, they should be back in class within 5 minutes. Only one student at a time may be allowed to leave the classroom for this purpose.
12. Students who are absent from the class for more than 5 meetings will get a final grade of 0.0 in the course.
13. Only students who are officially enrolled in the course are allowed to attend the class meetings.

Approved by:

DR. JOSE TRISTAN F. REYES
Chair, Mathematics and Statistics Department