**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 their matrix representation, 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.

<table>
<thead>
<tr>
<th>ELGA</th>
<th>Learning Outcome</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical and Creative Thinker</td>
<td>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.</td>
<td>1 2 3 4 5 6 7 8</td>
</tr>
<tr>
<td>Effective Communicator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifelong Learner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Program Outcomes (BS Mathematics)**
A graduate of the program should be able to

1. 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.
2. Demonstrate skills in pattern recognition, generalization, abstraction, critical analysis, problem-solving and rigorous argument.
3. 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.
4. Communicate mathematical ideas orally and in writing using clear and precise language.
5. Appreciate the concept and role of proof and reasoning and demonstrate knowledge in reading and writing mathematical proofs.

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

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Required Output</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Carefully crafted compilation of solved problems (theoretical exercises) that will manifest the application of the concepts learned</td>
<td>Problems will be given each week, and the students will submit the solutions on the following week. When the instructor has returned the solutions, the students will edit these and the compilation of</td>
</tr>
</tbody>
</table>
- Construct a concept map to illustrate the inter-relationships among the various concepts and processes studied in the course

### Rubric for assessment for compilation of solutions to problems

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Excellent (4)</th>
<th>Very Good (3)</th>
<th>Satisfactory (2)</th>
<th>Needs Improvement (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding of mathematical concepts</td>
<td>Shows complete understanding of the underlying mathematical concepts and principles needed to solve the problem.</td>
<td>Shows nearly complete understanding of the problem's mathematical concepts and principles.</td>
<td>Shows some understanding of the mathematical concepts and principles needed to solve the problem.</td>
<td>Shows very limited understanding of the problem's mathematical concepts and principles.</td>
</tr>
<tr>
<td>Clarity of Explanation</td>
<td>Explanation is well-written, complete and unambiguous. Terminologies and symbols are used correctly.</td>
<td>Explanation is clear but few simple details are missed. Terminologies and symbols are used appropriately.</td>
<td>Explanation is little difficult to understand. Some symbols and notations are used inappropriately.</td>
<td>Explanation is difficult to understand.</td>
</tr>
<tr>
<td>Understanding of methods of proof</td>
<td>Shows correct understanding of the method of proof. Statements are logical and the desired conclusion is arrived at.</td>
<td>Shows correct understanding of the method of proof. The proof proceeded logically except for a few minor errors.</td>
<td>Shows correct understanding of the method of proof but there are major errors in reasoning.</td>
<td>Lacks understanding of the method of proof but an attempt to solve the problem is evident.</td>
</tr>
</tbody>
</table>

### Rubric for assessment of concept map

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Excellent (4)</th>
<th>Very Good (3)</th>
<th>Satisfactory (2)</th>
<th>Needs Improvement (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding of Mathematical Concepts</td>
<td>Shows complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another</td>
<td>Shows almost complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another.</td>
<td>Shows a moderate degree of understanding of the concepts and processes studied in the course as well as their inter-relationships with one another.</td>
<td>Shows a limited degree of understanding of the concepts and processes studied in the course as well as their inter-relationships with one another.</td>
</tr>
<tr>
<td>Clarity of Presentation</td>
<td>The ideas presented are easily understood and the existing inter-relationships among the concepts and processes are clearly indicated.</td>
<td>Except for a few minor details, the ideas presented are easily understood and the existing inter-relationships among the concepts and processes are clearly indicated.</td>
<td>Some ideas are not clearly presented and some inter-relationships are either lacking or not correctly presented.</td>
<td>Many of the ideas presented and inter-relationships among concepts and processes are incorrect or lacking.</td>
</tr>
</tbody>
</table>
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 inter-relationships are either misplaced or not included.

Majority of the concepts, processes and inter-relationships are incorrectly placed or described, or are missing from the concept map.

Additional Requirements

- Quizzes/Seatwork
- Homework
- Final Exam

Grading System

<table>
<thead>
<tr>
<th>FOR EXEMPTED STUDENTS (w/out Final Exam)</th>
<th>FOR STUDENTS with FINAL EXAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>with no missed quiz</td>
<td>With one missed quiz</td>
</tr>
<tr>
<td>Average of quizzes</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>Final exam</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>60%</td>
</tr>
<tr>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>-</td>
<td>30%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES</th>
<th>TOPIC</th>
<th>WEEK NO.</th>
<th>LEARNING ACTIVITIES</th>
</tr>
</thead>
</table>
|                   | 1. Linear Equations and Matrices | Weeks 1-3 | • Cooperative Learning  
|                   | 1.1 Matrices and Matrix Operations |     | • Skills exercises  
|                   | 1.2 Algebraic Properties of Matrix Operations |     | • Seatwork  
|                   | 1.3 Special Classes of Matrices |     | • Computer Aided Exercises  
|                   | 1.4 The Echelon Form of a Matrix |     | • Problem Set*  
|                   | 1.5 Equivalent Matrices |     |                     |
|                   | 1.6 Solutions of Linear Systems |     |                     |
|                   | 1.7 The Inverse of a Matrix |     |                     |
|                   | 2. Determinants | Weeks 4-5 | • Cooperative Learning  
|                   | 2.1 Definition and Related Concepts |     | • Skills exercises  
|                   | 2.2 Properties of Determinants |     | • Seatwork  
|                   | 2.3 Cofactor Expansion |     | • Problem Set*  
|                   | 2.4 Inverse of a Matrix |     |                     |
|                   | 2.5 Cramer’s Rule |     |                     |
|                   | 3. Vector Spaces | Weeks 6-8 | • Cooperative Learning  
|                   | 3.1 Vector Spaces and Subspaces |     | • Library work  
|                   |                           |     | • Skills exercises  |

QUIZ 1

QUIZ 2- Includes Sections 3.1 and 3.2
| 3.2 Linear Combinations and Spanning Sets | • Seatwork  
| 3.3 Linear Independence | • Library work  
| 3.4 Bases and Dimension | • Cooperative Learning  
| 4. Linear Transformations | • Skills exercises  
| 4.1 Definitions and Examples | • Seatwork  
| 4.2 Isomorphisms | • Problem Set*  
| 4.3 Coordinate Vectors |  
| 4.4 Matrix of a Linear Transformation |  
| Quizzes 3 |  
| 5. Eigenvalues, Eigenvectors and Diagonalization | • Cooperative Learning  
| 5.1 Eigenvalues and Eigenvectors | • Library work  
| 5.2 The Characteristic Polynomial | • Skills exercises  
| 5.3 Diagonalization | • Seatwork  
| 5.4 Inner Product Spaces* | • Problem Set*  
| 5.5 Diagonalization of Symmetric Matrices* |  

**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. 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**


**Online Resources**


**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 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