



Undergraduate Program

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### TQF 3 Course Specifications

#### Section 1 General Information

1. Course code and course title

Thai ICMA 224 พีชคณิตเชิงเส้น ข

English ICMA224 Linear Algebra B

2. Number of credits 2 (2-0-4) (Lecture/Lab/Self-study)

3. Program and type of subject

3.1 Program Undergraduate Degree (International Program)

3.2 Type of Subject Applied Mathematics Core Course

4. Course Coordinator and Course Lecturer

4.1 Course Coordinator Asst. Dr. Pornrat Ruengrot

4.2 Course Lecturer Asst. Dr. Pornrat Ruengrot

5. Trimester/ Year of Study

5.1 Trimester Trimester 1,2 / All students in every Science Undergraduate Program

5.2 Course Capacity Approximately 30 students

6. Pre-requisite N/A

7. Co-requisites N/A

8. Venue of Study Mahidol University Salaya  
Campus



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## Section 2 Goals and Objectives

### 1. Course Goals

To provide students with foundational concepts of Linear Algebra which include vector spaces, linear transformations, eigenvalues and eigenvectors and inner product spaces.

### 2. Objectives of Course Development/Revision

#### 2.1 Course Objectives

Students should be able to use and applied theoretical knowledge of Linear Algebra to solve relevant problems.

#### 2.2 Course-level Learning Outcomes: CLOs

By the end of the course, students will be able to (CLOs)

1. CLO1 Communicate mathematical concepts and explain solutions to problems both verbally and in written sentences.
2. CLO2 Understand the meaning of vector spaces and relevant concepts.
3. CLO3 Understand the meaning of linear transformations, their associated eigenvalues and eigenvectors.
4. CLO4 Understand the meaning of inner product spaces and relevant concepts.



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### Section 3 Course Management

#### 1. Course Description

ปริภูมิเวกเตอร์ทั่วไป การแปลงเชิงเส้น ค่าเฉพาะและเวกเตอร์เฉพาะ ปริภูมิผลคูณภายใน

General vector spaces, linear transformations, eigenvalues and eigenvectors, Inner product spaces

#### 2. Credit hours per trimester

Lecture (Hour(s))	Laboratory/field trip/internship (Hour(s))	Self-study (Hour(s))
24 (2 hours x 12 weeks)	-	48 (4 hours x 12 weeks)

#### 3. Number of hours that the lecturer provides individual counseling and guidance.

1 hour/week

### Section 4 Development of Students' Learning Outcome



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1. Short summary on the knowledge or skills that the course intends to develop in students (CLOs)

By the end of the course, students will be able to

1. CLO1 Communicate mathematical concepts and explain solutions to problems both verbally and in written sentences.
2. CLO2 Understand the meaning of vector spaces and relevant concepts.
3. CLO3 Understand the meaning of linear transformations, their associated eigenvalues and eigenvectors.
4. CLO4 Understand the meaning of inner product spaces and relevant concepts.

2. Teaching methods for developing the knowledge or skills specified in item 1 and evaluation methods of the course learning outcomes

Course Code	Teaching methods	Evaluation Methods
CLO1	Reading assignment, problem assignment, group discussion, interactive lecture	Quizzes and Exams
CLO2	Reading assignment, problem assignment, group discussion, interactive lecture	Quizzes and Exams
CLO3	Reading assignment, problem assignment, group discussion, interactive lecture	Quizzes and Exams
CLO4	Reading assignment, problem assignment, group discussion, interactive lecture	Quizzes and Exams



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### Section 5 Teaching and Evaluation Plans

#### 1. Teaching plan

Week	Topic	Number of Hours		Teaching Activities/ Media	Lecturer
		Lecture Hours	Lab/Field Trip/Internship Hours		
1-3	General vector spaces	6	-	Reading assignment, problem assignment, group discussion, interactive lecture	PR*
	Subspaces, Spanning sets, Linear dependence/independence, basis, subspaces of a matrix				
4-6	Linear transformations	6	-	Reading assignment, problem assignment, group discussion, interactive lecture	PR
	Kernel and image, Rank-nullity theorem, Applications				
7-9	Eigenvalues and eigenvectors	6	-	Reading assignment, problem assignment, group discussion, interactive lecture	PR
	Diagonalization, Applications				
10-12	Inner product spaces	6	-	Reading assignment, problem assignment,	PR



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				group discussion, interactive lecture	
	Norm and distance, Orthogonality, Applications				
	Total	24	0		

\*PR = Dr. Pornrat Ruengrot

## 2. Plan for Assessing Course Learning Outcomes

### 2.1 Assessing and Evaluating Learning Achievement

#### a. Formative Assessment

- Individual quiz results
- Exam results
- Class discussion

#### b. Summative Assessment

##### (1) Tools and Percentage Weight in Assessment and Evaluation

Learning Outcomes	Assessment Methods	Assessment Ratio (Percentage)	
CLO1 Communicate mathematical concepts and explain solutions to problems both verbally and in written sentences	Written Examination	10	20
	Quiz/Assignment	10	
CLO2 Understand the meaning of vector spaces and relevant concepts	Written Examination	10	20
	Quiz/Assignment	10	
CLO3 Understand the meaning of linear transformations, their	Written Examination	20	40
	Quiz/Assignment	20	



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associated eigenvalues and eigenvectors			
CLO4 Understand the meaning of inner product spaces and relevant concepts	Written Examination	10	20
	Quiz/Assignment	10	
Total			100

(2) Grading System

Grade	Achievement	Final Score (% Range)	GPA
A	Excellent	90-100	4.0
B+	Very good	85-89	3.5
B	Good	80-84	3.0
C+	Fairly good	75-79	2.5
C	Fair	70-74	2.0
D+	Poor	65-69	1.5
D	Very Poor	60-64	1.0
F	Fail	Less than 60	0.0

(3) Re-examination (If course lecturer allows to have re-examination)

N/A - (Not applicable with MUIC)

3. Student Appeals

In writing to the Associate Dean of Academic Affairs and Research

**Section 6 Teaching Materials and Resources**

1. Textbooks and/or other documents/materials



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- 1) Kieth Nicholson W. Linear algebra with applications, 7th ed. McGraw-Hill, 2013
  - 2) Lay, David C. Linear Algebra and its applications, 4th edition, Addison-Wesley, 2003
  - 3) Anton H. Elementary linear algebra, 7th ed. USA: John Wiley & Sons Inc; 1994
2. Recommended textbooks and/or other documents/materials
- 1) Kieth Nicholson W. Linear algebra with applications, 7th ed. McGraw-Hill, 2013
  - 2) Lay, David C. Linear Algebra and its applications, 4th edition, Addison-Wesley, 2003
  - 3) Anton H. Elementary linear algebra, 7th ed. USA: John Wiley & Sons Inc; 1994
3. Other Resources (If any)
- Handouts

### **Section 7 Evaluation and Improvement of Course Management**

1. Strategies for evaluating course effectiveness by students
  - 1.1 Student feedback of instructors, teaching methods and materials, and course content through MUIC student evaluation forms
2. Strategies for evaluating teaching methods
  - 2.1 Evaluation of effectiveness based on student evaluation scores and comments
  - 2.2 Evaluation through peer observations by co-instructor or other Division faculty
3. Improvement of teaching methods
  - 3.1 Adjustments based on student feedback, personal observations, comments from peer observations and discussions with supervisor and/or other Division faculty in one-on-one and/or group meetings as specified by MUIC guidelines
4. Verification process for evaluating students' standard achievement outcomes in the course
  - 4.1 Verification through student performance on assessments based on MUIC/Division standards
5. Review and plan for improving the effectiveness of the course





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5.1 Course instructors (and coordinator/supervisor) will meet to discuss results of student evaluations and student performance based on learning outcomes in order to identify point for improvement

5.2 Strategy for improvement set according to MUIC/Division guidelines

Appendix

Alignment between Courses and Program

Table 1 The relationship between course and Program Learning Outcomes (PLOs)

Linear Algebra B	Program Learning Outcomes (PLOs)								
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7		
ICMA 224	I	I		I		I	I		

**Note:** Indicate the level of CLOs by letter I, R, P or M. Using the information as shown in the Curriculum Mapping of TQF2

Table 2 The relationship between CLOs and PLOs

ICMA 224	Program Learning Outcomes (PLOs)								
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO 1	1.1					6.1			
Communicate mathematical	1.2	2.1				6.3			



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concepts and explain solutions to problems both verbally and in written sentences	1.3								
CLO 2 Understand the meaning of vector spaces and relevant concepts	1.1					6.1			
	1.2	2.1		4.1		6.3			
	1.3								
CLO 3 Understand the meaning of linear transformations, their associated eigenvalues and eigenvectors.	1.1	2.1		4.1		6.1	7.1		
	1.2	2.2				6.3	7.3		
	1.3								
CLO4 Understand the meaning of inner product spaces and relevant concepts	1.1	2.1		4.1		6.1	7.1		
	1.2	2.2				6.3	7.3		
	1.3								

Table 3 The description of PLOs and Sub Los of the course



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PLOs	SubPLOs
<p>PLO1 Acquire the basic skills and conceptual understanding regarding differential, integral and multivariable calculus, as well as that of fundamental mathematical objects introduced in our core courses such as sets, functions, equations, vectors, matrices, and groups</p>	<p>1.1 Recognize and describe what mathematical knowledge is required for a given set of problems            1.2 Use appropriate technical skills to solve problems            1.3 Synthesize information to arrive at logical reasoning in the context of mathematics</p>
<p>PLO2 Use knowledge of content and mathematical procedures to solve problems and make connections between the different areas of mathematics</p>	<p>2.1 Apply concepts of mathematics to solving application problems            2.2 Connect, synthesize and/or transform ideas or solutions within a particular framework</p>
<p>PLO3 Demonstrate intellectual curiosity and a strong propensity towards independent learning</p>	<p>3.1 Demonstrate the analytical, communication, problem solving, interpersonal, and technical skills that will            3.2 Draw meaningful conclusion from the learning materials            3.3 Assess the relevance of the information</p>
<p>PLO4 Demonstrate mathematical thinking skills, progressing from a procedural and computational understanding of mathematics to logical reasoning, pattern recognition, generalization, and abstraction, and to a formal proof.</p>	<p>4.1 Demonstrate ability to think like a mathematician in the following aspects: critical thinking, problem solving, and quality of the thinking            4.2 Integrate alternative, divergent, or contradictory perspectives or ideas in the solution of a problem or question            4.3 Create an original explanation or solutions to the situations/problems</p>
<p>PLO5 Apply concepts of scientific integrity and commit to professional ethics and responsibilities and norms of the profession</p>	<p>5.1 Demonstrate moral and appropriate behavior            5.2 Recognize ethical issues related to mathematics            5.3 Identify national &amp; global current issues and their relations to mathematics            5.4 Apply accepted ethical standards to resolve issues            5.5 Collaborate effectively with others as a responsible team member            5.6 Demonstrate abilities to maintain an unbiased review and approaching the process for its value, expanding</p>



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PLO6 Communicate mathematical ideas orally and in writing, with precision, clarity and organization, using proper terminology and notation	6.1 Communicate/present ideas effectively both oral & written forms, proper to audience groups 6.2 Prepare a purposeful oral presentation 6.3 Prepare written documents to communicate information/ideas
PLO7 Acquire proficiency in the use of technology and numerical techniques to assist in learning and investigating mathematical ideas and in problem-solving	7.1 Describe process of transposing of data into computer-based information 7.2 Describe process of transposing of problems into computer-based information 7.3 Manage scientific projects using mathematical softwares