Program Industrial Engineering

Course Title   Mathematics II

Course Code   SCMA 102

Degree ☑ Bachelor ☐ Master ☐ Doctoral

Faculty of Science

Department of Mathematics

TQF 3   Course Specification

Section 1 General Information

1. Course code and title

Thai	วทคณ ๑๐๒ คณิตศาสตร์ ๒
English	SCMA 102 Mathematics II

2. Number of credits   4 (4–0–8) credits

Lecture 4 – Laboratory 0 – Self-study 8 hours/week

3. Program and category of the course

3.1 Program   Bachelor of Engineering Program in Industrial Engineering

(International Program, Interdisciplinary Program)

3.2 Category of the course   Specific Courses

4. Course responsible faculty member and instructors

4.1 Course responsible faculty member

Assoc. Prof. Nattapong Bosuwan

Department of Mathematics, Faculty of Science

E-mail address: nattapong.bos@mahidol.ac.th

4.2 Instructors

5. Semester / Level of study

5.1 Semester 2nd Semester / First year

5.2 Number of student   40-50 students

6. Pre-requisite

SCMA 101 Mathematics I

7. Co-requisites

None

8. Venue of study   Faculty of Science, Mahidol University, Salaya campus

9. Date of preparation/latest revision   January 2024

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Section 2 Goals and Objectives

๑. Course goals

This course intends to develop students' knowledge to explain and apply fundamental knowledge of infinite sequences and series, calculus on functions of several variables, differential equations, and linear algebra appropriate to real-world problem.

๒. Objectives of development/revision

๒.๑ Course objectives

Students should be able to explain definition and apply fundamental knowledge of infinite sequences and series, calculus on functions of several variables, differential equations, and linear algebra appropriate to real-world problem.

๒.๒ Course-level learning outcomes: CLOs

After successful completion of this course, students should be able to:

1) Explain definition and fundamental knowledge of infinite sequences and series, calculus on functions of several variables, differential equations, and linear algebra. (CLO1)

2) Examine the convergence of infinite sequences and series. (CLO2)

3) Solve ordinary differential equations and system of linear equations. (CLO3)

4) Apply differential equations and linear algebra to the real-world problems. (CLO4)

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Section 3 Description and Implementation

1. Course description

ลำดับอนันต์และอนุกรมอนันต์ ฟังก์ชันของหลายตัวแปร ลิมิตและความต่อเนื่องของฟังก์ชันหลายตัวแปร อนุพันธ์ย่อย สมการเชิงอนุพันธ์เชิงเส้นอันดับหนึ่ง สมการเชิงอนุพันธ์ไม่เชิงเส้นอันดับหนึ่ง สมการเชิงอนุพันธ์เชิงเส้นอันดับสูง การประยุกต์สมการเชิงอนุพันธ์ ระบบสมการเชิงเส้น พีชคณิตเชิงเส้น การประยุกต์พีชคณิตเชิงเส้น

Infinite sequences and series; functions of several variables; limits and continuity of functions of several variables; partial derivatives; first order linear differential equations; first order nonlinear differential equations; higher order linear equations; applications of differential equations; systems of linear equations; linear algebra; applications of linear algebra.

2. Credit hours/Semester

Lecture (hours)	Laboratory/Field trip/Internship (hours)	Self-study (hours)
4	0	8

3. Number of hours that the instructors provide individual counseling and guidance

Instructors provide academic counseling and guidance to individual at least 1 hour/week or upon request during office hours (Monday-Friday).

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Section 4 Development of Students' Learning Outcomes

1. Short conclusion on knowledge or skills that the course intends to develop students

After successful completion of this course, students should be able to:

1) Explain definition and fundamental knowledge of infinite sequences and series, calculus on functions of several variables, differential equations, and linear algebra.

2) Examine the convergence of infinite sequences and series.

3) Solve ordinary differential equations and system of linear equations.

4) Apply each concept to the real-world problems.

2. Method to evaluate students' learning outcome in this course and to evaluate the learning outcomes specified in the standard

The alignment of learning outcomes, teaching strategies and evaluation strategies is shown below.

SCMA 102 Mathematics II	Teaching strategies	Evaluation strategies
CLO1	Interactive lecture, effective questioning, formative assessment	- Individual assignment - Written exam
CLO2	Interactive lecture, effective questioning, formative assessment, problem solving	- Individual assignment - Written exam
CLO3	Interactive lecture, effective questioning, formative assessment, problem solving	- Individual assignment - Written exam
CLO4	Interactive lecture, effective questioning, formative assessment, problem based activities	- Individual assignment - Written exam

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Section 5 Teaching and Evaluation Plans

1. Teaching plan

Week	Topics	Number of hours (In-class activity – Lab)	Teaching method/ Media	Instructor
1	Infinite sequences	4 – 0	Interactive lecture, effective question-ing, formative assess-ment, problem solv-ing, problem based activities / lecture notes, slides, individual assign-ments	Assoc. Prof. Nattapong Bosuwan
2	Infinite series	4 – 0		
3	Functions of several variables - limit / continuity / partial derivatives - total differentials / total derivatives	4 – 0		
4	Differential equations - classification - initial value problems Techniques of solving first order ODEs - separable equations	4 – 0		
5	Techniques of solving first order ODEs - exact equations / integrating factor	4 – 0		
6	Techniques of solving first order ODEs - linear equations - Bernoulli's equations	4 – 0		
7	Techniques of solving first order ODEs - Homogeneous equations	4 – 0		
8	Midterm examination			
9	Higher order linear homogeneous ODEs	4 – 0		

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Week	Topics	Number of hours (In-class activity – Lab)	Teaching method/ Media	Instructor
	- fundamental concepts - constant-coefficient ODEs		Interactive lecture, effective question-ing, formative assess-ment, problem solv-ing, problem based activities / lecture notes, slides, individual assign-ments	Assoc. Prof. Nattapong Bosuwan
10	Higher order linear nonhomogeneous ODEs - Method of Undetermined Coefficients - Method of Variation of Parameters	4 – 0		
11	Applications of ODEs	4 – 0		
12	Systems of linear equations - Cramer's rule - row operation - existence and uniqueness theorem	4 – 0		
13	Vector space	4 – 0		
14	Linear transformation	4 – 0		
15	Eigenvalues and eigenvectors	4 – 0		
16	Diagonalization, applications of linear algebra	4 – 0		
17	Final Examination			

2. Evaluation plan

2.1 Learning measurement and evaluation

A. Formative assessment

Quiz and class observation.

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B. Summative assessment

(1) Evaluation methods and weight

Course Learning Outcomes	Evaluation			%Weight
	Individual work	Quizzes	Exams	
CLO1: Explain definition and fundamental knowledge of infinite sequences and series, calculus on functions of several variables, differential equations, and linear algebra.	7.5%	2.5%	15%	25%
CLO2: Examine the convergence of infinite sequences and series.	7.5%	2.5%	15%	25%
CLO3: Solve ordinary differential equations and system of linear equations.	7.5%	2.5%	15%	25%
CLO4: Apply each concept to the real-world problems.	7.5%	2.5%	15%	25%
Total	30%	10%	60%	100%

(2) Grading system

Students are evaluated their performance using assessment rubric according to course objectives and learning outcomes. Rubric scores for a single piece of individual work

Score	Description
20	Demonstrates the required work for all questions.
16	Demonstrates the required work for most questions with lower than 25% mistakes.
12	Demonstrates the required work for many questions with lower than 50% mistakes.
8	Demonstrates the required work for some questions with more than 50% mistakes.
4	Demonstrates the required work for few questions with more than 75% mistakes.
0	No response

The percentage of individual work is the average rubric scores of all pieces of individual work.

After completion of the evaluation process each student is assigned a criterion-referenced grade (as shown in the table below). Evaluation and achievement will be justify according to Faculty and University code, conducted by grading system of A, B+, B, C+, C, D+, D and F. To pass this course, student must earn a grade of at least D.

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Total percentage of evaluation	0 – 49	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 100
Grade	F	D	D+	C	C+	B	B+	A

3. Academic Appeal

Students may submit formal complaint or academic appeal directly to

International Education And Administration Unit**,** Division of Salaya Campus

Room SC1-116, SC1-Building, Faculty of Science (Salaya Campus), Mahidol University

999 Phuttamonthon 4 Road, A. Phuttamonthon, Nakhon Pathom 73170, Thailand

E-mail: scsim@mahidol.ac.th; Phone: + 66 2 4419820 ext. 1199.

If it is considered that a case exists, the matter will be investigated in accordance with the procedures, and the complainant informed of the outcome.

Section 6 Teaching Materials and Resources

1. Textbooks and required documents

1) Boyce WE. Elementary differential equations and boundary valued problems. 8th ed. New York: Wiley; 2006.

2) Ross SL. Introduction to ordinary differential equations. 4th ed. New York: Wiley; 1989.

3) James Stewart, Calculus: Early Transcendentals. 6th ed., Brooks Cole; 2007.

4) Anton H, Bivens I, Davis S. Calculus. 7th ed. New York: Wiley; 2002.

2. Suggested Materials

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3. Electronic information and websites (if any)

1) Available through MU Library-subscribed databases

2) https://www.khanacademy.org

3) https://www.edx.org

4) https://www.coursera.org

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5) http://tutorial.math.lamar.edu

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Section 7 Evaluation and Improvement of Course Management

1. Strategies for effective course evaluation by students

Evaluation of instructor and course through Mahidol University E-Evaluation System

2. Evaluation strategies in teaching methods

Evaluated by course evaluation by student (Mahidol University E-Evaluation System) and student performance (Section 5)

3. Improvement of teaching methods

Course responsible faculty member and instructors revise and improve strategies by reviewing of the output of the student evaluation. Review of turning-in individual work assignment quality as planned (Section 5) is used to adjust teaching method to enhance student's learning achievement.

4. Evaluation of students' learning outcomes

Analysis of students' learning outcomes using student's total percentage of evaluation taken from review of class attendance record, review of on-time assignment submission review of individual response according to examination rules and regulations, review of turning-in individual work assignment quality, and written examination by the course responsible faculty member and instructors. The evaluation results are peer-reviewed the international committee for undergraduate study of the Industrial Engineering Department.

5. Review and improvement plan for course effectiveness

Course responsible faculty member and instructors review course effectiveness in achieving course learning outcomes using outputs from course and instructor evaluation (Mahidol University E-Evaluation System), student evaluation (Section 5), and formal complaint or academic appeal (if any) to determine further improvement plan.

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Appendix

Alignment between course and program

Table 1 Curriculum mapping

Course title	Program learning outcomes							
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
SCMA 102 Mathematics II								

Table 2 Alignment between CLOs and PLOs

The PLOs in the table are the program learning outcomes of Bachelor of Engineering Program in Industrial Engineering (International Program, Interdisciplinary Program)

SCMA 102 Mathematics II	Program learning outcomes (PLOs)											
Course learning outcomes	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	R		R			I						
CLO2	R		R			I						
CLO3	R		R			I						
CLO4	R		R			I						

The course learning outcomes is introductory level (I).

The course learning outcomes (CLOs) are related to the following program learning outcomes, i.e.,

PLO1   Apply knowledge of mathematics, science, engineering and industrial engineering.

PLO3   Design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, professional ethical, health and safety, manufacturability, sustainability, and necessary legislation in the exercise of the Industrial Engineer profession.

PLO6   Demonstrate professional and ethical responsibility.

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Table 3 **PLOs and SubPLOs**

PLOs	SubPLOs
PLO1	1.1 ....
	1.3 ....
	1.4 ....
PLO3	3.4 ....
PLO4	4.2 ....
PLO7	7.2 ....