**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

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 10-30 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 2020

**Section 2 Goals and Objectives**

1. **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.

1. **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)

**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).

**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 |

**Section 5 Teaching and Evaluation Plans**

**1. Teaching plan**

| **Week** | **Topics** | **Number of hours (In-class activity** – **Lab)** | **Teaching method/****Media** | **Instructors** |
| --- | --- | --- | --- | --- |
| 1 | Infinite sequences | 4 – 0 | Interactive lecture, effective questioning, formative assessment, problem solving, problem based activities /lecture notes, slides, individual assignments | Dr. Watthanan Jatuviriyapornchai |
| 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 problemsTechniques of solving first order ODEs- separable equations | 4 – 0 |
| 5 | Techniques of solving first order ODEs- exact equations / integrating factor | 4 – 0 | Asst. Prof. Nattapong Bosuwan |
| 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- fundamental concepts- constant-coefficient ODEs | 4 – 0 | Interactive lecture, effective questioning, formative assessment, problem solving, problem based activities /lecture notes, slides, individual assignments | Asst. 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.

**B. Summative assessment**

(1) Evaluation methods and weight

|  |  |  |
| --- | --- | --- |
| **Course Learning Outcomes** | **Evaluation** | **%Weight** |
| **Individual work** | **Written exam** |
| CLO1: Explain definition and fundamental knowledge of infinite sequences and series, calculus on functions of several variables, differential equations, and linear algebra. | 10% | 15% | 25% |
| CLO2: Examine the convergence of infinite sequences and series. | 10% | 15% | 25% |
| CLO3: Solve ordinary differential equations and system of linear equations. | 10% | 15% | 25% |
| CLO4: Apply each concept to the real-world problems. | 10% | 15% | 25% |
| Total | 40% | 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.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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

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

**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.

**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.

**Table 3** **PLOs and SubPLOs**

|  |  |
| --- | --- |
| **PLOs** | **SubPLOs** |
| PLO1 ………………………………. | 1.1 ………………………………. |
|  | 1.3 ………………………………. |
|  | 1.4 ………………………………. |
| PLO3 ………………………………. | 3.4 ………………………………. |
| PLO4 ………………………………. | 4.2 ………………………………. |
| PLO7 ………………………………. | 7.2 ………………………………. |