TQF 3 Course Specifications
Section 1 General Information

1. Course code and course

title Thai ICMA 323 สมการเชิงอนุพันธ์ย่อย

English ICMA 323 Partial Differential Equations

2. Number of credits 4(4-0-8) (Lecture/Lab/Self-study)

3. Program and type of subject

3.1 Program Undergraduate Degree (International Program)

3.2 Type of Subject Applied Mathematics Required Course

4. Course Coordinator and Course Lecturer

4.1 Course Coordinator Asst. Prof. Pornrat Ruengrot

4.2 Course Lecturer Asst. Prof. Somsak Orankitjaroen

5. Trimester/ Year of Study

5.1 Trimester All trimesters / for all students in every Science Undergraduate Program

5.2 Course Capacity Approximately 30 students

6. Pre-requisite -

7. Co-requisites -

Section 2 Goals and Objectives

1. Course Goals

   To provide students with foundational concepts of partial differential equations which include heat equation, method of separation of variables, Fourier series, wave equation and Laplace's equation.

2. Objectives of Course Development/Revision

   2.1 Course Objectives

This course intends to develop students' knowledge to explain and apply fundamental knowledge of partial differential equations: first order equations (linear and nonlinear), heat equation, wave equation, and Laplace equation

2.2 Course-level Learning Outcomes: CLOs

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

1. CLO1 Classify the three types of linear second-order partial differential equations.
2. CLO2 Use the method of separation of variables to find particular solutions of separable partial differential equations.
3. CLO3 Solve various types of partial differential equations which are modeled from physical principles such as heat flow, vibrating strings and waves.
4. CLO4 Use Fourier series to solve some types of partial differential equations.

Section 3 Course Management

1. Course Description

สมการความร้อน วิธีการแยกตัวแปร อนุกรมฟูเรียร์ สมการคลื่น สมการลาปลาซ

Heat equation, method of separation of variables, Fourier series, wave equation, Laplace's equation.

2. Credit hours per trimester

Lecture (Hour(s))	Laboratory/field trip/internship (Hour(s))	Self-study (Hour(s))
48 (4 hours x 12 weeks)	-	96 hours (8 hours x 12 weeks)

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

1 hours/week

Section 4 Development of Students' Learning Outcome

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 Classify the three types of linear second-order partial differential equations.
2. CLO2 Use the method of separation of variables to find particular solutions of separable partial differential equations.
3. CLO3 Solve various types of partial differential equations which are modeled from physical principles such as heat flow, vibrating strings and waves.
4. CLO4 Use Fourier series to solve some types of partial differential equations.

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	Quiz, Midterm and Final

CLO2	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final
CLO3	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final
CLO4	Reading assignment, problem assignment, group discussion, Interactive lecture	Quiz, Midterm and Final

Section 5 Teaching and Evaluation Plans

1.Teaching plan

Class	Topic/Details	Number of hours		Instructors	Note
		In-Class sessions	Lab sessions		
1	Introduction to PDEs	2		PR	
2	Introduction to PDEs	2		PR	
3	Heat equation	2		PR	
4	Heat equation	2		PR	
5	Heat equation	2		PR	
6	Heat equation	2		PR	
7	Method of separation of variables	2		PR	
8	Method of separation of variables	2		PR	
9	Method of separation of variables	2		PR	
10	Fourier series	2		PR	
11	Fourier series	2		PR	
12	Fourier series	2		PR	
	Fourier series			PR	

Class	Topic/Details	Number of hours		Instructors	Note
		In-Class sessions	Lab sessions		
13	Fourier series	2		PR	
14	wave equation	2		PR	
15	wave equation	2		PR	
16	wave equation	2		PR	
17	wave equation	2		PR	
18	wave equation	2		PR	
19	Laplace's equation	2		PR	
20	Laplace's equation	2		PR	
21	Laplace's equation	2		PR	
22	Laplace's equation	2		PR	
23	Laplace's equation	2		PR	
24	Final exam review	2		PR	
	Final Exam			PR	
	Total	48	0		

* PR = Pornrat Ruengrot

2. Plan for Assessing Course Learning Outcomes

2.1 Assessing and Evaluating Learning Achievement

a. Formative Assessment

- Individual quiz results
- Midterm results
- Class discussion
- Reflective questions
- Answer comparison

b. Summative Assessment

(1) Tools and Percentage Weight in Assessment and Evaluation

Learning Outcomes	Assessment Methods	Assessment Ratio (Percentage)	
CLO1 Classify the three types of linear second-order partial differential equations	Midterm	5	12
	Quiz	5	
	Assignment	2	
CLO2 Use the method of separation of variables to find particular solutions of separable partial differential equations	Midterm	10	27
	Final	10	
	Quiz	5	
	Assignment	2	
CLO3 Solve various types of partial differential equations which are modeled from physical principles such as heat flow, vibrating strings and waves	Midterm	10	44
	Final	20	
	Quiz	10	
	Assignment	4	
CLO4 Use Fourier series to solve some types of partial differential equations	Midterm	10	17
	Quiz	0	
	Final	5	
	Assignment	2	
			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
   1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, John Wiley & Sons, Inc. 1993.
   2. R. Haberman, Elementary applied partial differential equations: with Fourier series and boundary value problems, 5th edition, Pearson 2013.
2. 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

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 Major courses

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

PDE	Program Learning Outcomes (PLOs)						
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
ICMA 323	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 Program LOs (Number in table = Sub LOs)

ICMA106	Learning Outcomes in Applied Mathematics Program						
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1 Classify the three types of linear second-order partial differential equations	1.1	2.1					
CLO2 Use the method of separation of variables to find particular solutions of separable partial differential equations	1.3	2.2		4.1		6.3	
CLO3 Solve various types of partial differential	1.2 1.3						

equations which are modeled from physical principles such as heat flow, vibrating strings and waves integrals to solve a variety of problems.							
CLO4 Use Fourier series to solve some types of partial differential equations	1.2	2.2				6.1	

Table 3 The description of Program LOs and Sub LOs of the course

Program LOs	Sub LOs
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	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
Use knowledge of content and mathematical procedures to solve problems and make connections between the different areas of mathematics	2.1 Apply concepts of mathematics to solving application problems 2.2 Connect, synthesize and/or transform ideas or solutions within a particular framework
Demonstrate intellectual curiosity and a strong propensity towards independent learning	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
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	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
Apply concepts of scientific integrity and commit to professional ethics and responsibilities and norms of the profession	5.1 Demonstrate moral and appropriate behavior 5.2 Recognize ethical issues related to mathematics 5.3 Identify national & 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
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
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