



Course **090245401**

Advanced Wireless Communications and Metering Infrastructure

King Mongkut's University of Technology North Bangkok

The Sirindhorn International Thai-German Graduate School of Engineering

Electrical and Software Systems Engineering Program

Section 1: General Information

1. Course code and course title

090245401 **Advanced Wireless Communications and Metering Infrastructure**

2. Total credits

3 credits ☐ (2-2-5) ☒ (3-0-6) ☐ (3-0-9) ☐ (2-3-7)

3. Curriculum and course category:

Curriculum: **Master of Engineering in Electrical and Computer Engineering**

Course category: Required Courses

☐ Core Course ☐ Specific Core Course

☐ Industrial Internship ☐ Master Thesis

Elective Courses

☐ General Elective ☒ Specific Elective ☐ Other Elective

4. Course coordinator/ Instructors

Course Coordinator: **Assoc. Prof. Dr. Soamsiri Chantaraskul**

Instructor(s): **Assoc. Prof. Dr. Chaiyod Pirak**

5. Semester/ year of study

☒ Semester 1 (Aug. to Dec.) ☐ Semester 2 (Jan. to May) Academic Year: **2021**

6. Pre-requisite (if any)

☒ No ☐ Yes, please provide:

7. Co-requisites (if any)

☒ No ☐ Yes, please provide:

8. Venue of study

Lecture Day/Time: **Tuesday at 13.00-16.00**

☐ On-site: Lecture Room No.:...1103..... Floor:.....11th.....

☒ TGGS, KMUTNB ☐ Faculty of Engineering, CU ☐ RWTH



Program: **ESSE**
Degree Level: **Master**

Faculty/College: **TGGS**

- ☒ On-line*: Teaching Media: ☐ Microsoft Teams ☐ Google Meet
☒ Zoom ☐ Webex
☐ Other (specify)

Remark: * During COVID-19, the teaching can be on-site and/or on-line according to TGGS Policy.

9. Information for quality assurance in education

This course shows evidence of:

- ☐ Development of implementation from previous practices, e.g. the improvement of class teaching, course content, content classification and methods used for learning assessment
- ☒ Involvement from professional bodies/ external agencies in instruction; thus Enhancing student academic and professional experiences
- ☐ Integration of research or creative activities with instruction; use of research-based learning management; knowledge management practices for learning improvement
- ☐ Integration of academic services and course implementation
- ☐ Combination of cultural heritage preservation efforts into instruction or student activities

10. Date of latest revision:

July 2020

Section 2: Course Description and Implementation

1. Course Description *(As written in the Official Approved Curriculum)*

Introduction to Wireless Communications. Probability Theory. Random Variables. Random Processes. Matrix definitions. Operations. and Properties. Path Loss. Shadowing. Statistical Multipath Channel Models. Digital Modulation and Detection. Performance of Digital Modulation over Wireless Channels. Multiple Access Techniques. Signal to Noise Power Ratio. Detection Error Probability. Smart Meters. Advanced Metering Infrastructure (AMI). Communication Network Architecture for Smart Grids. Meter Data Acquisition System. Meter Data Management System (MDMS). Anti-tampering Methodology. Smart Grid System Integration

2. Number of hours per semester

Lecture	Practice	Self-study
45 hours/ semester	30 hours	75 hours/ semester



Program: **ESSE**
Degree Level: **Master**

Faculty/College: **TGGS**

Lecture	Practice	Self-study
(3 hours/week*)	(2 hours/week*)	(5 hours/week*)

Remark: * Based on 15 weeks of lecture

Course Category: ☒ Lecture ☐ Practice ☒ Laboratory
Course Evaluation: ☒ A-F ☐ S/U ☐ P

3. Number of hours per week for academic guidance to individual students

☐ 1. Giving academic advice (minimally number hour per week) during the office hour

☐ 1 ☐ 2 ☒ 3 ☐ 4 ☐ 5 ☐

Tuesday at 09.00-12.00

The student can arrange the time other than the office hour via telephone or email for the meeting date/time.

☐ 2. Adopting information technology-based academic advising

☐ Email: chaiyod.p@tggs.kmutnb.ac.th

☐ Phone: 0858420590

(Do not distribute this mobile number without permission.)

☐ Communication Apps: Line ID: dr.chaiyod

(Please notify the lecturer when adding the line.)

☐ Meeting Online: The platform will be informed to students upon the request.

☐ Other (specify)

☐ 3.

4. Course Learning Outcomes (CLOs): Students should be able to:

CLO 1. To understand the theoretical concepts in the followings:

- Wireless communication systems
- Advanced metering infrastructure (AMI)

CLO 2. To apply the knowledge in designing the wireless communication systems, including the digital modulation/demodulation, the optimal receiver, and the signal constellation and decision region.

CLO 3. To apply the knowledge in designing the AMI systems, including the AMI smart meters, the communication technology for AMI systems, the Head-End System



(HES) and Meter Data Management System (MDMS), and the data analytics for AMI systems.

CLO 4. To analyze the performance of wireless communication systems and AMI systems by using both computer simulation and instruments.

CLO 5. To demonstrate the simulation results, experimental results, and assignments given in the class to the publics

Remark: 1. Guidelines according to Bloom's Taxonomy is available at https://courses.dcs.wisc.edu/design-teaching/PlanDesign_Fall2016/2-Online-Course-Design/2_Learning-Objectives-Alignment/6_objectives_blooms-taxonomy.html

2. For the master level course, CLOs should be "apply" and "analyze" or possibly to consider the doctoral CLOs "evaluate" and "create". "Remember" and "Understand" are for the undergraduate level courses, however, they can be implemented only at the beginning of the course.

3. CLOs can be defined as many as appropriated for the course.

5. The mapping between Expected Learning Outcomes (ELOs) from the curriculum and Course Learning Outcomes (CLOs)

Table 5.1 ELOs-CLOs Consistency (for a subject-specific course; a specific curriculum)

ELOs/CLOs consistency	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
ELO1	✓				
ELO2				✓	
ELO3		✓	✓		
ELO4					
ELO5					
ELO6					
ELO7					✓
ELO8					
ELO9					
ELO10					

Remark: All ELOs and ELOs for the course (highlighted row) are as written in the Official Approved Curriculum.

Table 5.2 Mapping desirable characteristics of KMUTNB graduates and CLOs (for non-specific courses designed for various curriculums)



Consistency between desirable characteristics of KMUTNB Graduates- CLOs	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
1. Professional credentials with critical thinking skills				✓	
2. Integrity and social responsibility					✓
3. Innovative and technopreneur mindset		✓	✓		
4. Global Competence	✓				

Section 3: Student Improvement in relation to Course Learning Outcomes (CLOs)

Organizing learning to develop skills/ knowledge; evaluation of CLOs in accordance with the ones identified in Section 2.4

Course Learning Outcomes (CLOs)	Teaching Methods compliant with CLOs	Evaluation Methods compliant with CLOs
CLO 1	<ul style="list-style-type: none"> Lecture* Active learning** In-class exercises Individual and/or group assignment Additional reading assignments from research and/or literature journals 	<ul style="list-style-type: none"> Assignment evaluation Assessment of assigned exercises Exam****
CLO 2	<ul style="list-style-type: none"> Case studies, project-based learning In-class exercises Individual and/or group assignment Group discussions 	<ul style="list-style-type: none"> Assignment evaluation Assessment of assigned exercises Exam****
CLO 3	<ul style="list-style-type: none"> Case studies, project-based learning In-class exercises Individual and/or group assignment Group discussions 	<ul style="list-style-type: none"> Assignment evaluation Assessment of assigned exercises Exam****



Course Learning Outcomes (CLOs)	Teaching Methods compliant with CLOs	Evaluation Methods compliant with CLOs
CLO 4	<ul style="list-style-type: none">• Lecture on how to analyze the performance mathematically and numerically• Demonstration on the use of computer software for simulations and/or writing the computer code for numerical simulations• In-class exercises• Group discussions on project updates• Mentoring on the problem solving	<ul style="list-style-type: none">• Assignment evaluation• Assessment of assigned exercises• Exam****
CLO 5	<ul style="list-style-type: none">• Case studies, project-based learning• In-class exercises• Additional reading assignments from research and/or literature journals• Group discussions on project updates• Project/Assignment presentation and publish in the social media for public education	<ul style="list-style-type: none">• Assignment evaluation• Assessment of assigned exercises• Assessment a content quality of a video clip posted on the social media

Remark: * Lecture on the concept of the topic is introduced with basic or fundamental definitions, visualization and correlations. For the complicated equation, the derivation from the basic laws can be shown to students. So, the students do not memorize the equations but understand the basic concept and basic equation. The lecturer will introduce the advanced and new concepts, technologies, and findings to students from publications such as journals and websites and from the research and industrial experiences.

** Active learning by asking questions related to the topic in the lecture and encouraging the students to response to the questions. If the students cannot response with answers, then the lecturer will give some guidance until the students can response.

*** Quiz in the closed-book format on the basic concepts and equations with simple problem solving to evaluate their learning. The solution will be given to students after grading, so they can identify their mistakes and weakness.

**** Exam on the basic concepts and equations with simple problem solving in the closed-book format as a review, whereas the complicated integrated problem solving will be worked in the open-book format.

**Section 4: Lesson Plan and Evaluation****1. Lesson Plan**

Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
1	Introduction to wireless communications	CLO 1	3.0	<ul style="list-style-type: none">• Lecture presentation slides• Q&A• Examples and Case Studies	Assoc. Prof. Dr.Chaiyod Pirak
2	Probability theory	CLO 1	3.0	<ul style="list-style-type: none">• Lecture presentation slides• Q&A• Examples and Case Studies• In-class exercises• Assignment No. 1	Assoc. Prof. Dr.Chaiyod Pirak
3	Random variables and random processes	CLO 1	3.0	<ul style="list-style-type: none">• Lecture presentation slides• Q&A• Examples and Case Studies• In-class exercises• Assignment No. 2	Assoc. Prof. Dr.Chaiyod Pirak
4	Path loss, shadowing, and Statistical multipath fading channel models	CLO 1 CLO 2	3.0	<ul style="list-style-type: none">• Lecture presentation slides• Q&A• Examples and Case Studies• In-class exercises• Assignment No. 3	Assoc. Prof. Dr.Chaiyod Pirak
5	Digital modulation and transmitter design	CLO 1 CLO 2	3.0	<ul style="list-style-type: none">• Lecture presentation slides• Q&A• Examples and Case Studies• In-class exercises• Assignment No. 4	Assoc. Prof. Dr.Chaiyod Pirak



Program: **ESSE**
Degree Level: **Master**

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Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
6	Digital demodulation and receiver design	CLO 1 CLO 2	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises Assignment No.5 	Assoc. Prof. Dr.Chaiyod Pirak
7	Midterm Examination	CLO 4	3.0	<ul style="list-style-type: none"> Paper-based examination 	Assoc. Prof. Dr.Chaiyod Pirak
8	Digital communication performance analysis and system examples, e.g 5G system and IoT	CLO 1 CLO 2	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises Assignment No.6 	Assoc. Prof. Dr.Chaiyod Pirak
9					
10	Introduction to Advanced Metering Infrastructure	CLO 1	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies Project assignment 	Assoc. Prof. Dr.Chaiyod Pirak
11	Smart Meter Design and Communication Technologies-Part I	CLO 1 CLO 3	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises Assignment No.7 	Assoc. Prof. Dr.Chaiyod Pirak
12	Smart Meter Design and Communication Technologies-Part II	CLO 1 CLO 3	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises Assignment No.8 	Assoc. Prof. Dr.Chaiyod Pirak



Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
13	DLMS/Cosem Protocol and Interoperability-Part I	CLO 1 CLO 3	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises Assignment No.9 	Assoc. Prof. Dr.Chaiyod Pirak
14	DLMS/Cosem Protocol and Interoperability-Part II	CLO 1 CLO 3	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises 	Assoc. Prof. Dr.Chaiyod Pirak
15	IT Infrastructure and System Integration – Part I	CLO 1 CLO 3 CLO 4	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises Assignment No.10 	Assoc. Prof. Dr.Chaiyod Pirak
16	IT Infrastructure and System Integration – Part II	CLO 1 CLO 3 CLO 4	3.0	<ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies In-class exercises 	Assoc. Prof. Dr.Chaiyod Pirak
17	Project Presentation	CLO 1 CLO 2 CLO 3 CLO 4 CLO 5	3.0	<ul style="list-style-type: none"> Presentation of Students Video clip evaluation on the social media 	Assoc. Prof. Dr.Chaiyod Pirak
18	Midterm Examination	CLO 4	3.0	<ul style="list-style-type: none"> Paper-based examination 	Assoc. Prof. Dr.Chaiyod Pirak
		Total	54.0		

**2. Evaluation Plan (in accordance with OBE 2 mapping framework)**

Course Learning Outcomes (CLOs)	Evaluation Methods	Week of Evaluation	Percentage of Evaluation
CLO 1, 2, 3	10 Assignments	2-6, 8-15	15%
CLO 4	2 Exams	7, 18	70%
CLO 1, 2, 3, 4, 5	1 Project Assignment	10, 17	10%
	Participation	1-18	5%

Section 5 Teaching/Learning Resources**Textbooks and materials**

- Main Text:
1. C. Pirak. Mobile Radio Systems (A Lecture Companion)
 2. Andrea Goldsmith "Wireless Communications", Cambridge University Press, 2005.
 3. John G. Proakis "Digital Communications" 4th Edition, McGraw-Hill, 2001.

Section 6 Course Evaluation and Improvement**1. Course evaluation by students**

The students will have an opportunity to evaluate the effectiveness of the course in a form of paper survey and group interview at the end of each semester. The results of survey and interview including the grading will be reviewed by the curriculum meeting to evaluate the course's effectiveness.

2. Strategies for assessing learning management

The students will have an opportunity to evaluate the teaching of the course in a form of paper survey and group interview at the end of each semester. The results of survey and interview including the grading will be reviewed by the curriculum meeting to evaluate the teaching as well as returning to the lecturer for further improvement.

3. Improvement schemes of course implementation



The evaluation from the students including the grading will be submitted to the curriculum meeting for reviewing and brainstorming to improve teaching of each course. Comments and suggestions given by the curriculum meeting will be informed to the responsible lecturer of each course.

4. Verification of students learning outcomes, referred to OBE 2 and 3

The grading of this course will be evaluated and reviewed by the Department meeting and the TGGS executive board meeting in order to verify its appropriateness before the final approval.

5. Course review and improvement plans

The results of the grading evaluation and student evaluation will be submitted to the curriculum meeting for reviewing and brainstorming to improve the effectiveness of the offered courses. Comments and suggestions will be informed to the responsible lecturer of each course.