



Program: **ECE**
Degree Level: **Master**

Faculty/College: **TGGS**

Course **090245122**

Mobile Radio Networks

King Mongkut's University of Technology North Bangkok
The Sirindhorn International Thai-German Graduate School of Engineering
Electrical and Computer Engineering Program

Section 1: General Information

1. Course code and course title

090245122 **Mobile Radio Networks**

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: _____

Instructor(s): **Assoc. Prof. Dr. Soamsiri Chantaraskul**

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: **Tuesdays at 09.00-12.00**

☒ On-site: Lecture Room No.:.....511.....Floor:....5....

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

☒ 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:

- 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

10. Date of latest revision:

July 2021

Section 2: Course Description and Implementation**1. Course Description** (*As written in the Official Approved Curriculum*)

Introduction of mobile radio networks and historical review; the cellular systems; system architecture and evolution from GSM system towards 5G system emphasising on different multiple access methods; WCDMA/UMTS network architecture; system design choices and principles behind; 4G and 5G network and core technology; introduction to technologies for the next generation networks such as Software Defined Radio (SDR), Cognitive Radio network, and Heterogeneous Networks (HetNets); WLANs based on the IEEE 802.11 standard; basic aspects of the physical layer as well as the medium access and operational issues; introduction to standards/systems supporting the short range communications such as Bluetooth (802.15.1), ZigBee (802.15.4), etc; wireless sensor network: applications and network management.

2. Number of hours per semester

| Lecture | Practice | Self-study |
|---------------------------------------|-----------------------------|---------------------------------------|
| 45 hours/ semester (3 hours/week*) | 30 hours (2 hours/week*) | 75 hours/ semester (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 ☐

The student can arrange the time via telephone or email for the meeting date/time.

- ☐ 2. Adopting information technology-based academic advising

☐ Email: soamsiri.c@tggs.kmutnb.ac.th



Program: **ECE**
Degree Level: **Master**

Faculty/College: **TGGS**

- ☐ Phone: 02-5552929
- ☐ Communication Apps: Line ID:
(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 fundamental concepts of the well-known mobile radio networks and realize the principle techniques used in WCDMA/UMTS and 4G networks
- CLO 2 To analyze the performance enhancement through mobile network evolution and the implemented solutions in comparison with the previous systems.
- CLO 3 To explore the principles of the WLAN with the IEEE 802.11 standard in order to understand the idea behind this widely deployed system.
- CLO 4 To understand the concepts of several short range communication systems, which are vastly implemented in the modern devices
- CLO 5 To investigate into the current research trend in mobile radio networks and criticize on the mechanisms proposed.

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 | CLO5 |
|-----------------------|-------|-------|-------|-------|------|
| 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)*



Program: **ECE**
Degree Level: Master

Faculty/College: TGGs

| 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** Individual assignment | <ul style="list-style-type: none"> Assignment evaluation Quiz*** Exam**** |
| CLO 2 | <ul style="list-style-type: none"> Lecture* in relation with the currently used techniques and protocol mechanisms Case studies/ In-class examples In-class mechanism analysis Individual assignment | <ul style="list-style-type: none"> Assignment evaluation Quiz*** Exam**** |
| CLO 3 | <ul style="list-style-type: none"> Lecture* in relation with the currently used standards and protocol mechanisms Active learning** Individual assignment | <ul style="list-style-type: none"> Assignment evaluation Quiz*** Exam**** |
| CLO 4 | <ul style="list-style-type: none"> Lecture* in relation with the currently used standards and mechanisms Application case studies Individual assignment | <ul style="list-style-type: none"> Assignment evaluation Quiz*** Exam**** |



| Course Learning Outcomes (CLOs) | Teaching Methods compliant with CLOs | Evaluation Methods compliant with CLOs |
|---------------------------------|--|--|
| CLO 5 | <ul style="list-style-type: none"> In-class mechanism analysis Additional reading from research and/or literature journals Individual assignment (report) | <ul style="list-style-type: none"> Assignment (report) evaluation Presentation |

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 | Part 1: Introduction to wireless networks, cellular concept | CLO 1 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 2 | Part 2: GSM overview, WCDMA introduction and system architecture | CLO 1 CLO 2 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 3, 4 | WCDMA radio access technique, spread spectrum | CLO 1 CLO 2 | 6.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies Assignment No. 1 | Dr. Soamsiri |



Program: **ECE**
Degree Level: **Master**

Faculty/College: **TGGS**

| Week | Topics/Details | CLOs | Hours | Learning and teaching activities; teaching media (if any) | Lecturer |
|-----------|--|----------------|-------|---|--------------|
| | | | | <ul style="list-style-type: none"> Quiz No. 1 | |
| 5 | WDMA radio interface protocol, WCDMA radio network planning | CLO 1 CLO 2 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 6 | 4G overview and system architecture | CLO 1 CLO 2 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 7 | 4G radio access technique and the future trend | CLO 1 CLO 2 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 8 | Midterm Exam including all topics from week 1-7 | | 3.0 | <ul style="list-style-type: none"> Paper-based examination | Dr. Soamsiri |
| 9 | Part 3: IEEE 802.11 standard overview, WLAN system architecture, protocol structure, physical layer of IEEE 802.11 | CLO 3 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 10 | IEEE 802.11 medium access control, Recent extensions of IEEE 802.11 | CLO 3 | 3.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |
| 11, 12 | Part 4: WPAN, Bluetooth – standard, topology, protocol architecture ZigBee – IEEE 802.15.4 standard, topology, PHY and MAC | CLO 4 | 6.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies Assignment No. 2 | Dr. Soamsiri |
| 13, 14 | Wireless sensor networks | CLO 4 | 6.0 | <ul style="list-style-type: none"> Lecture presentation slides Q&A Examples and Case Studies | Dr. Soamsiri |



Program: **ECE**
Degree Level: **Master**

Faculty/College: **TGGS**

| Week | Topics/Details | CLOs | Hours | Learning and teaching activities; teaching media (if any) | Lecturer |
|------|--|-------|-------|--|--------------|
| 15 | Project Presentation & Report | CLO 5 | 3.0 | <ul style="list-style-type: none"> • Assignment (report) • Presentation • Q&A | Dr. Soamsiri |
| 16 | Final Exam including all topics from week 9-14 | | 3.0 | <ul style="list-style-type: none"> • Paper-based examination | Dr. Soamsiri |
| | | Total | 48.0 | | |

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, 4, 5 | 2 Assignments / 1 Presentation | 3, 12, 15 | 15% |
| CLO 1, 2, 3, 4 | 1 Quiz | 4 | 10% |
| CLO 1, 2, 3, 4 | 2 Exams | 8, 16 | 70% |
| | Attendance | 1-16 | 5% |

Section 5 Teaching/Learning Resources

Textbooks and materials

- T. Rappaport, Wireless Communications, Prentice-Hall
- William Stallings, "Wireless Communications and Networks", Prentice-Hall, 2005
- Toskala & Holma, "WCDMA for UMTS, J. Wiley", 4th Ed., 2008
- Andrew Richardson, "WCDMA Design Manual, Cambridge Univ. Press
- Erik Dahlman, Stefan Parkvall, and Johan Sköld, "4G LTE/LTE-Advanced for Mobile Broadband", Elsevier
- Christopher Cox, "An Introduction to LTE", Wiley
- Anwer Al-Dulaimi, Xianbin Wang, and Chih-Lin I, "5G Networks", Wiley
- Hrishkesh Venkataraman and Ramona Trestian, "5G Radio Access Networks: Centralized RAN, Cloud-RAN, and Virtualization of Small Cells", Taylor & Francis
- Matthew Gast, "802.11 Wireless Networks: The Definitive Guide", O'Reilly, 2005
- Ian F. Akyildiz and Mehmet Can Vuran, "Wireless Sensor Networks", Wiley



- Walteneagus Dargie and Christian Poellabauer, "Fundamental of Wireless Sensor Networks: Theory and Practice", Wiley

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.