



## 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



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- 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. Explain fundamental concepts of the well-known mobile radio networks and comprehend the principle techniques used in WCDMA/UMTS, 4G, and 5G networks.
- CLO 2 Analyze the performance enhancement approaches through mobile network evolution and the implemented solutions in comparison with the previous systems.
- CLO 3 Identify the principles of the WLAN with the IEEE 802.11 standards and perceive the reasons on the effectiveness of each proposed technique behind this widely deployed systems.
- CLO 4 Clarify the concepts of several short range communication systems, which are vastly implemented in the modern devices.
- CLO 5 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.



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



Course Learning Outcomes (CLOs)	Teaching Methods compliant with CLOs	Evaluation Methods compliant with CLOs
	<ul style="list-style-type: none"> <li>Application case studies</li> <li>Individual assignment</li> </ul>	<ul style="list-style-type: none"> <li>Exam****</li> </ul>
CLO 5	<ul style="list-style-type: none"> <li>In-class mechanism analysis</li> <li>Additional reading from research and/or literature journals</li> <li>Individual assignment (report and presentation)</li> </ul>	<ul style="list-style-type: none"> <li>Assignment (report) evaluation</li> <li>Presentation with Q&amp;A</li> </ul>

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 respond to the questions. If the students cannot respond with answers, then the lecturer will give some guidance until the students can respond.

\*\*\* 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"> <li>Lecture presentation slides</li> <li>Q&amp;A</li> <li>Examples and Case Studies</li> <li>Quiz No. 1</li> </ul>	Dr. Soamsiri
2	Trunk and Grade of Service, Cellular network history, GSM overview,	CLO 1 CLO 2	3.0	<ul style="list-style-type: none"> <li>Lecture presentation slides</li> <li>Q&amp;A</li> <li>Examples and Case Studies</li> <li>Quiz No. 2</li> </ul>	Dr. Soamsiri
3-4	Part 2:	CLO 1 CLO 2	6.0	<ul style="list-style-type: none"> <li>Lecture presentation slides</li> <li>Q&amp;A</li> </ul>	Dr. Soamsiri



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Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
	WCDMA introduction, system architecture, WCDMA radio access technique, spread spectrum, WDMA radio interface protocols			<ul style="list-style-type: none"> <li>• Examples and Case Studies</li> <li>• Assignment No. 1</li> <li>• Quiz No. 3 and 4</li> </ul>	
5	UMTS radio network planning, UMTS radio resource management	CLO 1 CLO 2	3.0	<ul style="list-style-type: none"> <li>• Lecture presentation slides</li> <li>• Q&amp;A</li> <li>• Examples and Case Studies</li> <li>• Quiz No. 5</li> </ul>	Dr. Soamsiri
6	Part 3: 4G overview, system architecture, 4G radio access technique, HetNet, inter-cell interference coordination, LTE scheduling mechanisms	CLO 1 CLO 2	3.0	<ul style="list-style-type: none"> <li>• Lecture presentation slides</li> <li>• Q&amp;A</li> <li>• Examples and Case Studies</li> <li>• Quiz No. 6</li> </ul>	Dr. Soamsiri
7	Part 4: 5G enabling techniques, standardization and 5G timeline, advanced network architecture, 5G radio access networks, NOMA, ultra-dense networking, 5G deployment options	CLO 1 CLO 2	3.0	<ul style="list-style-type: none"> <li>• Lecture presentation slides</li> <li>• Q&amp;A</li> <li>• Examples and Case Studies</li> <li>• Quiz No. 7</li> </ul>	Dr. Soamsiri
8	Midterm Exam including all topics from week 1-6		3.0	<ul style="list-style-type: none"> <li>• Paper-based examination</li> </ul>	Dr. Soamsiri
9	Part 5: IEEE 802.11 standard overview, WLAN system architecture, protocol structure, IEEE	CLO 3	3.0	<ul style="list-style-type: none"> <li>• Lecture presentation slides</li> <li>• Q&amp;A</li> <li>• Examples and Case Studies</li> <li>• Quiz No. 8</li> </ul>	Dr. Soamsiri



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Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
	802.11 medium access control				
10	IEEE 802.11 management operation, physical layer of IEEE 802.11, recent extensions	CLO 3	3.0	<ul style="list-style-type: none"> <li>Lecture presentation slides</li> <li>Q&amp;A</li> <li>Examples and Case Studies</li> <li>Quiz No. 9</li> </ul>	Dr. Soamsiri
11	Part 6: WPAN, Bluetooth – standard, topology, protocol architecture ZigBee – IEEE 802.15.4 standard, topology, PHY and MAC	CLO 4	3.0	<ul style="list-style-type: none"> <li>Lecture presentation slides</li> <li>Q&amp;A</li> <li>Examples and Case Studies</li> <li>Assignment No. 2</li> <li>Quiz No. 10</li> </ul>	Dr. Soamsiri
12, 13	Part 7: Wireless sensor networks, applications, architecture and protocol stack, network and node management	CLO 4	6.0	<ul style="list-style-type: none"> <li>Lecture presentation slides</li> <li>Q&amp;A</li> <li>Examples and Case Studies</li> <li>Quiz No. 11 and 12</li> </ul>	Dr. Soamsiri
14	Project Presentation & Report	CLO 5	3.0	<ul style="list-style-type: none"> <li>Assignment (report)</li> <li>Presentation</li> <li>Q&amp;A</li> </ul>	Dr. Soamsiri
15	Final Exam including all topics from week 9-14		3.0	<ul style="list-style-type: none"> <li>Paper-based examination</li> </ul>	Dr. Soamsiri
		Total	45.0		

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	1 Assignment / 1 Presentation	4, 15	15%
CLO 1, 2, 3, 4	10 Quiz	1-7, 9-13	15%



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Course Learning Outcomes (CLOs)	Evaluation Methods	Week of Evaluation	Percentage of Evaluation
CLO 1, 2, 3, 4	2 Exams	8, 15	65%
	Attendance	1-15	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
- Waltenequs 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.