**Program**: ECE **Faculty/College**: TGGS
**Degree Level**: Master

# Course 090245136

# Microwave Components and Circuit Design

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**

   090245136 Microwave Components and Circuit Design

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.-Ing. Suramate Chalermwisutkul

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: Thursdays at 09.00-12.00

   ☑ On-site: Lecture Room No.:……410…….Floor:…4….

   □ TGGS, KMUTNB □ Faculty of Engineering, CU □ RWTH

   ☑ On-line*: Teaching Media: □ Microsoft Teams ☑ Google Meet

   □ Zoom □ Webex

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□ 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*)

Review of electromagnetic field theory. Network theory and generalization. S-parameters, signal flow graph and Smith chart. Design of planar circuits such as filters, dividers, couplers and matching networks. Microwave electronic devices including diodes, BJTs, MESFETs and HEMTs. Design of low noise amplifiers and power amplifiers. Basic principles and design for receivers and transmitters.

**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: suramate.c@tggs.kmutnb.ac.th

□ Phone: 02-5552000 ext 2912

□ Communication Apps: Line ID:

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(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. Recognize importance of microwave components in wireless communication systems and choose them correctly according to system's specification

CLO 2. Perform measurements of microwave components.

CLO 3. Develop fundamental knowledge for further research work in this area for students interested in this field.

**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 |
|---|---|---|---|
| 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 |
|---|---|---|---|
| 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 | • Lecture*<br>• Active learning**<br>• Individual assignment | • Assignment evaluation<br>• Exam**** |
| CLO 2 | • Lecture*<br>• Active learning**<br>• Individual assignment | • Assignment evaluation<br>• Exam**** |
| CLO 3 | • Lecture*<br>• Active learning**<br>• Individual assignment | • Assignment evaluation<br>• Exam**** |

*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.*

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## Section 4: Lesson Plan and Evaluation

1. **Lesson Plan**

| Week | Topics/Details | CLOs | Hours | Learning and teaching activities; teaching media (if any) | Lecturer |
|---|---|---|---|---|---|
| 1 | Relations between EM Theory and Network Theory | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |
| 2 | Network analysis using Graph Theory | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |
| 3 | Network parameters e.g. Z, Y, H, ABCD and Wave Parameters, | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |
| 4 | Network parameters e.g. Z, Y, H, ABCD and Wave Parameters | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |
| 5 | Transmission Line Theory | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |
| 6 | N-port S Parameters | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |
| 7 | N-port S Parameters, | CLO 1, CLO 2 | 3.0 | ● Lecture presentation slides<br>● Q&A<br>● Examples and Case Studies | Dr. Suramate |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Passive Microwave Components | CLO 1, CLO 2 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies<br>• Assignment | Dr. Suramate |
| 9 | Microwave Integrated Circuits | CLO 1, CLO 2 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 10 | Smith Chart | CLO 1, CLO 2 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 11 | Microwave Electronic Devices | CLO 1, CLO 2 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 12 | Small-signal Amplifiers and Oscillators | CLO 1, CLO 2 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 13 | Small-signal Amplifiers and Oscillators | CLO 1, CLO 2 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 14 | Circuit Design and Simulation using CAD Software | CLO 1, CLO 2 and CLO 3 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 15 | Examples and review for examination preparation | CLO 1, CLO 2 and CLO 3 | 3.0 | • Lecture presentation slides<br>• Q&A<br>• Examples and Case Studies | Dr. Suramate |
| 16 | Final Exam including all topics | CLO 1, CLO 2 and CLO 3 | 3.0 | • Paper-based examination | Dr. Suramate |
| | | 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 | Assignment | 14 | 40% |
| CLO 1, 2, 3 | Exam | 16 | 55% |
| | Attendance | 1-16 | 5% |

## Section 5 Teaching/Learning Resources

**Textbooks and materials**

- Lecture Notes on Microwave Circuits, Prof. Dr.-Ing. Rolf H. Jansen, Chair of Electromagnetic Theory, Faculty of Electrical Engineering and Information Technology, RWTH Aachen University, Germany
- Microwave Engineering, David M Pozar, Wiley
- Frederick H. Raab, Peter Asbeck, Steve Cripps, Peter B. Kenington, Zoya B. Popovic´, Nick Pothecary, John F. Sevic and Nathan O. Sokal, “Power Amplifiers and Transmitters for RF and Microwave” IEEE Transactions on Microwave Theory and Techniques, vol. 50, no. 3, March 2002

## 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.

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