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

Course 090245135

Electromagnetic Field Theory for Smart Sensing Applications

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**

   090245135 Electromagnetic Field Theory for Smart Sensing Applications

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

□ 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*)

Maxwell's equations, Time-dependent fields: plane wave propagation; characteristics and power flow. Solution of boundary-value problems for time-harmonic fields, Relation between field theory and circuit theory: lump elements and transmission lines. Applications of electromagnetic field theory for smart industrial and medical sensing.

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:

(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. Calculate fields' quantities using Maxwell's equations, describe time-dependent fields: plane wave propagation, characteristics, and power flow as well as solution of boundary-value problems for time-harmonic fields.

CLO 2. Describe relations between field theory and circuit theory: lump elements and transmission lines.

CLO 3. Develop fundamental knowledge for further research work in this area for students interested in this field especially applications of electromagnetic field theory for smart industrial and medical sensing.

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	CLO 1	CLO 2	CLO 3

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

KMUTNB Graduates- CLOs			
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* • Active learning** • Individual assignment	• Assignment evaluation • Exam****
CLO 2	• Lecture* • Active learning** • Individual assignment	• Assignment evaluation • Exam****
CLO 3	• Lecture* • Active learning** • Individual assignment	• Assignment evaluation • 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	Solution of Boundary Value Problems	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
2	Quasi-stationary Fields: Quasistatic or Quasistationary Fields, Continuity Equation	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
3	Quasi-stationary Fields: Displacement Current Density, Total Current Density, 1st and 2nd Maxwell's Equation	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
4	Time-Dependent Fields: Harmonic Time-Dependence, Maxwell's Equations	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
5	Time-Dependent Fields: Propagation Processes, Propagation Velocity of Planar Waves	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
6	Power Balance for the Electromagnetic Field	CLO 1, CLO 2 and CLO 3	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate

7	Power Balance for the Electromagnetic Field (cont.)	CLO 1, CLO 2 and CLO 3	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
8	Fields in a Conducting Medium, Skin-Effect, Reflection and Transmission at Plate of Finite Conductivity	CLO 1, CLO 2 and CLO 3	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies • Assignment	Dr. Suramate
9	Vector Wave Potentials: Wave Propagation in a Given Direction	CLO 1, CLO 2 and CLO 3	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
10	Vector Wave Potentials: Ideal Wave Guides, TEM, Quasi-TEM	CLO 1, CLO 2 and CLO 3	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
11	Vector Wave Potentials: Examples	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
12	Separation of the Helmholtz Equation	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
13	Separation of the Helmholtz Equation	CLO 1	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
14	Examples and review for examination preparation, Assignment	CLO 1 and CLO 2	3.0	• Lecture presentation slides • Q&A • Examples and Case Studies	Dr. Suramate
15	Examples and review for examination preparation	CLO 1 and CLO 2	3.0	• Lecture presentation slides • Q&A • 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 Electromagnetic Field Theory, Prof. Dr.-Ing. Rolf H. Jansen, Chair of Electromagnetic Theory, Faculty of Electrical Engineering and Information Technology, RWTH Aachen University, Germany
- Robert Plonsey and Robert E. Collins, Principles and Applications of Electromagnetic Fields, McGraw-Hill Book Company, London 1961

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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