

SYLLABUS

1. Course name: Microwave Circuits

2. Course code: MICI421964E

3. Credits: 3 (3/0/6)

Duration: 15 weeks (45 hours for in-class and 90 hours for self-study)

4. Instructors

1. Lê Minh Thành, MEng.
2. Nguyễn Văn Phúc, MEng.

5. Course conditions

Prerequisites: Microwave Engineering

Corequisites: N/A

6. Course description

This course provides students the knowledge of the microwave devices such as resistors, capacitors, inductors, diodes, BJTs, and MOSFETs. In addition, analysis and design of the matching circuits are used in many microwave circuits related to microwave amplifiers, oscillators, filters, power dividers and couplers.

7. Course goals

Goals	Goal description <i>This course provides students:</i>	ELOs
G1	Basic knowledge of the theory and analytical methods of signals and systems in microwave circuits.	01 (H)
G2	An ability of manipulating the analytical methods and evaluating the performance of the problems in microwave field.	02 (M)
G3	An ability of using software in simulating and designing some basic microwave circuits.	03 (M)
G4	An ability of identifying the concepts and techniques related to practical microwave circuits.	07(M)
G5	An ability of analysing and designing microwave circuits.	10 (L), 11(H)

* Notes: H: **High**; M: **Medium**; L: **Low**

8. Course learning outcomes (CLOs)

CLOs	Description <i>After completing this course, students can:</i>	ELOs
G1	G1.1 Understand the significance of the applications of the practical systems.	01, 07
	G1.2 Use the scattering parameters to analyse the power dividers and couplers.	
	G1.3 Understand the principles and apply the analytical methods to design the microwave filters.	

	G1.4	Understand the principles and represent the equivalent circuits of microwave devices.	
	G1.5	Understand and apply the suitable methods for explanation of the conditional and unconditional stability, impedance matching in microwave amplifier.	
	G1.6	Understand the principles of mixer, oscillators, and multipliers.	
	G1.7	Understand to simulate the microwave circuits by professional softwares.	
G2	G2.1	Identify the types of power dividers and couplers.	02
	G2.2	Identify the circuit diagrams and use the appropriate designs for microwave filters.	
	G2.3	Identify the microwave devices.	
	G2.4	Identify the requirements for the microwave amplifier designs.	
	G2.5	Identify and classify the oscillators, mixers and multipliers.	
G3	G3.1	Understand the parameters and simulation of the microwave circuits by using ADS/HFSS/AWR software.	03
	G3.2	Apply the ADS/HFSS/AWR software for simulating the microwave circuits.	
G4	G4.1	Understand the relations of the scattering parameters in microwave circuits.	07
	G4.2	Understand the needs of the microwave applications in communication systems.	
	G4.3	Use simulations to analyse and evaluate the performances of the microwave circuits.	
G5	G5.1	Identify, analyse, and explain the principles of power dividers and couplers.	10, 11
	G5.2	Analyse and design the microwave filters.	
	G5.3	Analyse and design the microwave amplifiers.	
	G5.4	Explain, analyse, and evaluate the parameters of oscillators, mixers, and multipliers.	

9. Study materials

a. Textbooks:

- [1] David M. Pozar, *Microwave Engineering*, 4th edition, Wiley, 2012, ISBN: 0-47-063155-4.

b. References:

- [1] S.Y. Liao, *Microwave Devices and Circuits*, 3rd edition, Prentice Hall, 1990, ISBN: 0-13-583204-7.
- [2] Vũ Đình Thành, *Mạch siêu cao tần*, NXB ĐHQG-HCM, 2015, ISBN: 978-604-73-3127-7.

10. Student assessments

a. Grading points: 10

b. Plan for student assessments is followed:

Types	Contents	Time-lines	Assessment techniques	CLOs	Rates (%)
Formative assessments					50
H.1	Covering the contents from	Week 5	Homework	G1.1, G1.2,	5

	chapter 1 to chapter 3.			G1.3 G2.1, G2.2 G4.1, G4.2 G5.1, G5.2	
H.2	Covering the contents from chapter 4 to chapter 6.	Week 11	Homework	G1.1, G1.4, G1.5, G1.6 G2.3, G2.4, G2.5 G4.1, G4.2 G5.3, G5.4	5
Q	Examine the ability of analysis and evaluation of the students by using multi-choice tests.	Week 12	Multi-choice on LMS	G1, G2, G4, G5	10
M.1	Covering the contents from chapter 1 to chapter 3.	Week 6	Paper-based individual assessment in class	G1.1, G1.2, G1.3 G2.1, G2.2 G4.1, G4.2 G5.1, G5.2	15
M.2	Covering the contents from chapter 4 to chapter 6.	Week 10	Paper-based individual assessment in class	G1.1, G1.4, G1.5, G1.6 G2.3, G2.4, G2.5 G4.1, G4.2 G5.3, G5.4	15
Summative assessments					50
F	Covering all contents related to the expected learning outcomes of the course.		Essay report	G1, G2, G3, G4, G5	50

* Notes: Q: **Quiz**; H: **Homework**; P: **Project**; M: **Midterm Exam**; F: **Final Exam**;

11. Course details:

Weeks	Contents	CLOs
1	Chapter 1. Overview of microwave circuits (3/0/6)	G1.1, G4.2
	Contents: (3) 1.1 Introduction to microwave circuits. 1.2 Microwave systems. Teaching methods: + Slide presentation + Questions and discussion	
	Self-study contents: (6) 1.3 Scattering matrix [S].	
2	Chapter 2. Power dividers and directional couplers (3/0/6)	

	<p>Contents: (3)</p> <p>2.1 Basic properties of dividers and couplers.</p> <p>2.2 The T-junction power dividers.</p> <p>2.3 The Wilkinson power dividers.</p> <p>Teaching methods:</p> <p>+ Slide presentation</p> <p>+ Questions and discussion</p>	G1.1, G1.2, G2.1, G4.1, G4.2, G5.1
	<p>Self-study contents: (6)</p> <p>2.4 Waveguide directional couplers.</p> <p>2.5 Coupled line directional couplers.</p>	
3	Chapter 2. Power dividers and directional couplers (cont'd) (3/0/6)	
	<p>Contents: (3)</p> <p>2.6 The quadrature hybrid.</p> <p>2.7 The 180-degree hybrid.</p> <p>Teaching methods:</p> <p>+ Slide presentation</p> <p>+ Questions ad discussion</p>	G1.1, G1.2, G2.1, G4.1, G4.2, G5.1
	<p>Self-study contents: (6)</p> <p>2.8 Lange coupler.</p> <p>2.9 Other couplers.</p>	
4	Chương 3. Microwave filters (3/0/6)	
	<p>Contents: (3)</p> <p>3.1 Concepts.</p> <p>3.2 Periodic structures.</p> <p>3.3 Filter design by the image parameter method.</p> <p>Teaching methods:</p> <p>+ Slide presentation</p> <p>+ Questions and discussion.</p>	G1.1, G1.3, G2.2, G4.1, G4.2, G5.2
	<p>Self-study contents: (6)</p> <p>3.4 Filter transformations.</p>	
5	Chapter 3. Microwave filters (cont'd) (3/0/6)	
	<p>Contents: (3)</p> <p>3.5 Filter design by the insertion loss method.</p> <p>3.6 Coupled line filters.</p> <p>3.7 Filters using coupled resonators.</p> <p>Teaching methods:</p> <p>+ Slide presentation</p> <p>+ Questions and discussion.</p>	G1.1, G1.3, G2.2, G4.1, G4.2, G5.2
	<p>Self-study contents: (6)</p> <p>3.8 Filter Implementation.</p>	
6	Revision and formative test 1	

7	Chapter 4. Microwave devices (3/0/6)	
	Contents: (3) 4.1 Diodes and diode circuits. 4.2 Bipolar junction transistors. 4.3 Field effect transistors. Teaching methods: + Slide presentation + Questions and discussion	G1.1, G1.4, G2.3, G4.1
	Self-study contents: (6) 4.4 Microwave integrated circuits. 4.5 Microwave tubes.	
8	Chapter 5. Microwave amplifiers (3/0/6)	
	Contents: (3) 5.1 Overview of microwave amplifiers. 5.2 Two-port power gains. 5.3 Stability. Teaching methods: + Slide presentation + Questions and discussion	G1.1, G1.5, G2.4, G4.1, G4.2, G5.3
	Self-study contents: (6) 5.4 Tests for unconditional stability.	
9	Chapter 5. Microwave amplifiers (cont'd) (3/0/6)	
	Contents: (3) 5.5 Single-stage transistor amplifier design. 5.6 Broadband transistor amplifier design. Teaching methods: + Slide presentation + Discussion	G1.1, G1.5, G2.4, G4.1, G4.2, G5.3
	Self-study contents: (6) 5.7 Power amplifiers.	
10	Revision and formative test 2	
11	Chapter 6. Oscillators and mixers (3/0/6)	
	Contents: (3) 6.1 RF oscillators. 6.2 Microwave oscillators. Teaching methods: + Slide presentation + Questions and discussion	G1.1, G1.6, G2.5, G4.1, G4.2, G5.4
	Self-study contents: (6) 6.3 Oscillation condition.	

12	Chapter 6. Oscillators and mixers (cont'd) (3/0/6)	
	Contents: (3) 6.4 Frequency multipliers. 6.5 Mixers. Teaching methods: + Slide presentation + Questions and discussion	G1.1, G1.6, G2.5, G4.1, G4.2, G5.4
	Self-study contents: (6) 6.6 Oscillator phase noise.	
13	Chương 7. Analysis and simulation of microwave circuits (3/0/6)	
	Contents: (3) 7.1 Introduction to ADS (AWR/HFSS). 7.2 Simulation of power dividers and couplers. Teaching methods: + Slide presentation + Questions and answers	G1.1, G1.7, G3.1, G4.1, G4.2, G5.4
	Self-study contents: (6) Set up the required software.	
14	Chapter 7. Analysis and simulation of microwave circuits (cont'd) (3/0/6)	
	Contents: (3) 7.3 Simulation of microwave amplifiers. 7.4 Simulation of microwave filters. Teaching methods: + Slide presentation + Questions	G1.1, G1.7, G3.1, G4.1, G4.2, G5.4
	Self-study contents: (6) Do the assigned homework	
15	Review and assign the topics.	

12. Learning ethics:

Homework assignments and projects must be done by the students themselves. Plagiarism found in the assessments will get point of zero..

13. First approved date: 15 / 01 / 2012

14. Approval level:

Dean

Department

Instructor

Nguyễn Minh Tâm, PhD.

Nguyễn Ngô Lâm, MEng.

Lê Minh Thành, MEng.

15. Syllabus updated process

<i>1st updated content date: 15/01/2014</i>	Instructor: Lê Minh Thành, MEng. Head of dept.: Võ Minh Huân, PhD.
<i>2nd updated content date: 15/01/2016</i>	Instructor: Lê Minh Thành, MEng. Head of dept.: Phan Văn Ca, PhD.