SYLLABUS

1. **Course name:** Microwave Engineering
2. **Course code:** MIEN330364E
3. **Credits:** 3 credits (3/0/6) (3 theoretical credits, 0 practical credit)
   Duration: 15 weeks ((3 main periods and 6 self-study periods) /week)
4. **Instructors:**
   a. Primary instructor: Le Minh Thanh, M.Eng
   b. Secondary instructor: Nguyen Van Phuc, M.Eng
5. **Course conditions**
   Prerequisites: N/A.
   Corequisites: Electric Circuit, Electromagnetic Field.
6. **Course Description:**

This course provides fundamental knowledge about ultra-high-frequency circuits (1GHz - 300GHz): characteristics of transmission lines, kinds of transmission lines, calculate reflection coefficient, impedance and admittance line, using Smith chart to perform matching impedance in a transmission line, calculate and analyze the physical significance of [S] matrix parameters and other characteristic matrices.

7. **Course Goals:**

Goals	***Goal description*** *(This course provides students:)*	**ELOs**
G1	Background knowledge and analysis about ultra high frequencie circuits: transmission equations, solution of transmission equations, reflection phenomenon, standing wave phenomenon, impedance and admittance in a transmission line, Smith chart and scattering matrix S.	01 (H)
G2	Ability to analyze, explain and solve technical problems of ultra-high frequency transmission.	02 (M)
G3	Calculate, design to meet the requirements of matching power in a system.	07 (M)

** Note: H: **H**igh; M: **M**edium; L: **L**ow*

8. **Course Learning Outcomes - CLOs:**

CLOs		***Description*** *(After completing this course, students can have:)*	**ELOs**
G1	G1.1	Present the frequency ranges in telecommunication engineering, ultra high frequencies and applications.	01, 07
	G1.2	Distinguish lumped circuit element and distributed element of transmission line.	01, 07
	G1.3	Present the physical significance of transmission equations' root.	01, 07
	G1.4	Present the primary and secondary parameters of the transmission line, the real transmission medium, the loss on the transmission line.	01, 07
	G1.5	Represent the reflection phenomenon, standing wave phenomenon, variation of impedance and admittance along the transmission line.	01, 07
	G1.6	Represent the pulsed response in time domain and the Bergeron method.	01, 07
	G1.7	Learn about the Smith chart	01, 07

	G1.8	Represent the relation between incident wave, reflection wave and voltage, current, the significance of incident wave and reflection wave, and analyze the significance of the scattering matrix coefficients in an ultra high frequency network.	02
	G1.9	Present the relation of scattering matrix [S] and other characteristic matrices: [Y], [Z], [ABCD], [T].	01, 07
G2	G2.1	Compare the advantages and disadvantages of the actual transmission lines.	02
	G2.2	Compare the advantages and disadvantages of matching impedance types.	02
	G2.3	Analyze and explain the significance of the scattering matrix coefficients in an ultra high frequency amplifier, in a microstrip antenna.	02
G3	G3.1	Calculate the reflection coefficient, impedance line and standing wave ratio of the transmission line.	02, 07
	G3.2	Calculate the scattering matrix [S] of some basic networks.	02, 07
	G3.3	Design of impedance matching circuits at the input and output of an ultra high frequency amplifier.	02, 07

9. Study materials:

a. Textbook:

[1] Vu Dinh Thanh, *Lý thuyết cơ sở kỹ thuật siêu cao tần*, Education publisher, 2005.

b. References:

[2] David M. Pozar, *Microwave Engineering*, 4th edition, John Wiley & Sons, Inc., 2012, ISBN-10: 0470631554.

[3] Samuel Y. Liao, *Microwave Devices and Circuits*, Prentice Hall, 3rd edition, 1996, ISBN-10: 0135832047.

[4] Christopher Bowick, *RF Circuit Design*, 2nd edition, Newnes, 1982, ISBN-10: 0750685182.

10. Student Assessments:

a. Grading points: 10

b. Planning for student assessments is followed:

Type	Contents	Linetime	Assessment techniques	CLOs	Rates (%)
Midterms					**50**
H.1	Chapter 2 and chapter 3	Week 4	Individual homework	G1.2, G1.3, G1.4, G1.5, G2.1, G3.1	2.5
H.2	Chapter 6 and chapter 7	Week 8	Individual homework	G1.7, G2.2, G3.1	2.5
M.1	Chapter 3 and chapter 4	Week 6	Individual paper test in class	G1.5, G3.1	20
M.2	Chapter 6 and chapter 7	Week 10	Individual paper test in class	G1.7, G2.2, G3.1, G3.3	20
Q	Knowledge of all chapters.	Week 15	Online test		5
Final exam					**50**
F	Content includes all output standards of the course.		Individual paper assessment in class		50

** Note: Q: **Q**uiz; H: **H**omework; P: **P**roject; M: **M**idterm Exam; F: **F**inal Exam;*

11. Course details:

Week	Contents	CLOs
1	***Chapter 1. Introduction of Microwave engineering*** *(3/0/6)*	
	Teaching contents: *(3)* 1.1 Introduction. 1.2 Radio frequency table. 1.3 Ultra high frequency. 1.4 Ultra high frequency field and applications. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.1
	Self-study contents: *(6)* 1.5 Maxwell equations.	
2	***Chapter 2. Transmission line*** *(3/0/6)*	
	Teaching contents: *(3)* 2.1 Transmission line model and Primary parameters. 2.2 Transmission equations. 2.3 Secondary parameters. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.2, G1.3, G1.4, G2.1
	Self-study contents: *(6)* 2.4 The actual transmission lines.	
3	***Chapter 3. Reflection phenomenon and standing wave phenomenon*** *(3/0/6)*	
	Teaching contents: *(3)* 3.1 Reflection phenomenon. 3.2 Reflection coefficient. 3.3 Standing wave phenomenon. 3.4 Standing wave ratio. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.4, G1.5, G3.1
	Self-study contents: *(6)* 3.5 Loss on the transmission line.	
4	***Chapter 4. Impedance and admittance*** *(3/0/6)*	
	Teaching contents: *(3)* 4.1 Definition of impedance line. 4.2 Calculate impedance line. 4.3 Relation between impedance line and reflection coefficient. 4.4 Admittance line. 4.5 Normalized impedance and admittance. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.5, G3.1
	Self-study contents: *(6)*	

	4.6 Half wavelength and a quarter wavelength transmission line.	
5	***Chapter 5. Transient on the transmission line****(3/0/6)*	
	Teaching contents: *(3)* 5.1 Pulsed response in time domain. 5.2 The Bergeron method. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.6
	Self-study contents: *(6)* 5.3 Measure parameters of transmission line.	
6	***Mid-term test 1***	
7	***Chapter 6: Smith chart****(3/0/6)*	
	Teaching contents: *(3)* 6.1 Smith chart's structure. 6.2 Notes of the Smith chart. 6.3 Impedance and admittance on the Smith chart. 6.4 Find reflection coefficient, standing wave ratio on the Smith chart. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.5, G1.7, G3.1
	Self-study contents: *(6)* 6.5 Node and antinode on the Smith chart.	
8	***Chapter 7: Matching impedance by using the Smith chart*** *(3/0/6)*	
	Teaching contents: *(3)* 7.1 Matching impedance by using lumped components. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.5, G2.2, G3.3
	Self-study contents: *(6)* 7.2 Advantages and disadvantages of matching impedance by using lumped components.	
9	***Chapter 7: Matching impedance by using the Smith chart*** (*cont-*)*(3/0/6)*	
	Teaching contents: *(3)* 7.3 Matching impedance by using stub. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.5, G2.2, G3.3
	Self-study contents: *(6)* 7.4 Compare the matching impedance types.	
10	***Mid-term test 2***	
11	***Chapter 8: Scattering matrix [S]*** *(3/0/6)*	
	Teaching contents: *(3)* 8.1 N-port network. 8.2 Definition of scattering matrix [S]. 8.3 Relations between incident/reflection wave and voltage, current.	G1.8

	8.4 The significance of incident wave [a] and reflection wave [b]. **Teaching methods**: + Theoretical lectures + Questions and discussion	
	Self-study contents: *(6)* 8.5 Measure the [S] parameters.	
12	***Chapter 8: Scattering matrix [S]*** *(cont-) (3/0/6)*	
	Teaching contents: *(3)* 8.6 The significance of the scattering matrix coefficients. 8.7 Characteristics of scattering matrix. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.8, G2.3, G3.2
	Self-study contents: *(6)* 8.8 Shift normalized plane of scattering matrix.	
13	***Chapter 9: Relations of scattering matrix and other characteristic matrices*** *(3/0/6)*	
	Teaching contents: *(3)* 9.1 Impedance matrix [Z]. 9.2 Admittance matrix [Y]. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.8, G1.9, G3.2
	Self-study contents: *(6)* 9.3 Exercises.	
14	***Chapter 9: Relations of scattering matrix and other characteristic matrices*** *(cont-) (3/0/6)*	
	Teaching contents: *(3)* 9.4 T matrix. 9.5 ABCD matrix. **Teaching methods**: + Theoretical lectures + Questions and discussion	G1.8, G1.9, G3.2
	Self-study contents: *(6)* 9.6 Scattering matrix of some 2-port networks.	
15	***Review***	

12. Learning ethics:

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

13. First approved date: January 15th 2012

Approval level:

Dean	Department	Instructor
Nguyen Minh Tam, Ph.D	Nguyen Ngo Lam, M.Eng	Nguyen Van Phuc, M.Eng

14. Syllabus updated process

1st time: Updated content dated: 15/01/2014 *Contents:*	**Instructor:** **Head of department:** Vo Minh Huan, Ph.D
2nd time: Updated content dated*:* 15/01/2016 *Contents:*	**Instructor:** **Head of department:** Phan Van Ca, Ph.D
3rd time: Updated content dated*:* 06/05/2017 *Contents:*	**Instructor:** Nguyen Van Phuc, M.Eng **Head of department:** Phan Van Ca, Ph.D