COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL of ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**EEE.7-2.2**	SEMESTER	7th
COURSE TITLE	MICROWAVES I		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Lectures		4	6
Lab Exercises		1	
Total		5	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background		
PREREQUISITE COURSES:	EEE.5.4: Electromagnetic Fields II		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	eee.uniwa.gr		

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course deals with the fundamental principles of transmission lines in the scientific area of RF electronic systems and high frequency devices. The transmission line theory is a prerequisite in order to understand the operation of microwave waveguides and cavities - subjects which require a strong background in electromagnetic theory. The course is compulsory under the group of Communications and Networks courses in the 6th semester. It is also a prerequisite course for Microwaves II, Antennas, and Electromagnetic Compatibility.

The object of the course is to introduce students to the concept of transmission lines and waveguides not only as a high frequency power transmission medium but also as a circuit element with distributed electrical characteristics. These elements are building blocks for high-frequency circuits, since it is not always possible to use discrete components. The object of the course is, also, the study of wave propagation in bounded media, the comprehension of standing waves, as well as the analysis of the transmission lines circuitry. The course focuses particularly on microwave waveguides and analyzes the issues of guided modes, power, matching techniques and excitation. The complementary laboratory exercises aim mainly at a better understanding of the issues that are analyzed in theory, both through appropriate equipment and through simulation software.

Upon successful completion of the course the students will be able to:

- Describe the wave propagation phenomena via transmission lines at high frequencies
- Describe the fundamental types of transmission lines and how they differentiate and operate in the frequency range up to the microwave frequencies
- Explain the concept of distributed characteristics and define the characteristic impedance of transmission lines
- Explain the concept of incident and reflected waves, as well as the generation of standing waves along a transmission line
- Calculate the pattern of the standing wave for various terminations, the input impedance for line circuitry, and the ability to match them using a stub and/or a λ / 4 transformer.
- Compute passive components at high frequencies using open and short circuited transmission lines
- Calculate the basic parameters of the lines through the Smith chart
- Apply the electromagnetic theory to calculate guided modes in the waveguides
- Explain the concept of guided modes and their cut-off frequencies waveguides

- Analyze the field profile and calculate the fundamental mode characteristics in rectangular waveguides
- Calculate resonant frequencies in rectangular microwave cavities

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Teamwork
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. RF transmission lines – coaxial cables – microstrips and waveguides
   Distributed parameters and differential equations of the uniform transmission line
2. Voltage and current along infinite transmission lines
   Characteristic impedance – transmission coefficient
3. Voltage and current in terminated lines – input impedance of a transmission line
   Forward, reflected and standing waves – voltage and current reflection coefficients - matched lines
4. Properties of lossless lines.
   Propagation velocity – group velocity – distortion and Heaviside condition. Open and short-circuited lines. Equivalent two-port models.
5. Lossless lines, standing wave ratio and voltage standing waves. Standing wave patterns on terminated lossless lines.
   Properties of open and short-circuited lossless lines
6. Impedance matching via a λ/4 transformer – resonant frequencies of λ/4 and λ/2 transmission line resonators
   The use of Smith chart – one stub matching method
7. Microwave waveguides: Elements of electromagnetic theory – Maxwell equations
   Wave equation – planar electromagnetic waves
8. Planar TEM waveguides
   Rectangular waveguides – boundary conditions – TE waves
9. Rectangular waveguides – boundary conditions – TM waves
   Cutoff frequencies of guided modes
10. Field profile of guided modes
    Propagation velocity – characteristic impedance - losses
11. Study of the fundamental TE10 mode of a rectangular waveguide
    Guided Power – excitation – scattering matrix
12. Circular waveguide – coaxial line – microstrip
    Microwave cavities – rectangular cavities
13. Resonant frequencies – cavity quality factor - cavity excitation – applications

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	52
study and analysis of bibliography	102
laboratory practice, fieldwork,	36
Course total	*180*

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	I. Written exams (60% ή 80%): - multiple choice questionnaires - short-answer questions - problem solving II. Optional written work, essay/report (20%) III. Laboratory work (20%): - Written exams - Written report - Oral examination

(5) ATTACHED BIBLIOGRAPHY

- D.M.Pozar, Microwave Technology,
- S.Y.Liao, Microwave devices and circuits, Prentice Hall, 1980.
- R.E.Collin, Foundations for Microwave engineering, McGraw Hill 1992
- LUDWIG L., BOGDANOV G., RF circuit design, Pearson, 2009.
- JOHNSON A., Transmission Lines and Networks, McGraw-Hill, 1975.