COURSE TRAINING PROGRAM FORM

Course Name	Code	Regular Semester	ECTS Credits	Credits	Lecture	3
					Application	0
Computer-Aided Analysis, Modeling, and Design of Microwave Networks by The Wave Approach	*0144670*	*7-8*	*6*	*3*	Laboratory (Hour/Week)	0

Compulsory or Elective	**Elective**
Instructor	Prof. Dr. Taner ŞENGÖR
Course Contents	-Wave-Based Representation of Microwave Networks. Scattering Matrix Representation. Physical Interpretation of Scattering Parameters. Two-Port-to-Three-Port Scattering Matrix Transformation. Scattering Matrices of an Embedded Multiport Network. -Frequency Domain Analysis of Microwave Networks Using Wave Computation. Connection Scattering Matrix Method. Computation of Network Response Functions. Overall Scattering Parameters. -Noise Analysis of Microwave Networks Using Noise Waves. Noise Wave Representation of Noisy Microwave Networks. Other Noise Representations of Noisy Networks and Their Transformations to Noise Wave Parameters. Noise Wave Correlation Matrices of Embedded Multiport Networks. Noise Analysis of Arbitrary Topology Linear Multiport Networks. The Algorithm For Noise Figure Computation. -Microwave Network Sensitivity Analysis Using the Wave Approach. Transposed Matrix Method for Sensitivity Analysis. Group Delay Computation of Microwave Network Transmission Functions. Sensitivity Computation of the Overall Scattering Parameters. -Solution of Systems of Circuit Equations Using Sparse Matrix Techniques. Bi-Factorization. Computation of the Solution Vector. Implementation of Sparse Matrix Techniques for Microwave Network Equations With Wave Variables. -Microwave Network Optimization Techniques. Definition of Microwave Network Optimization Problem. Generalized l_p Objective Function. Constraints on Optimized Network Parameters. -Time Domain Microwave Network Analysis Using Waves and Frequency Domain Data. Time Domain Network Analysis Using Waves. -Nonlinear Microwave Network Analysis Using Waves. Linear and Nonlinear Subnetworks. Parametric Description of Nonlinear Devices. Harmonic Balance Method. -Noise Wave Parameter Measurements. Microwave Six-Port Noise Wave Parameter Analyzer. Interferometer System for Noise Wave Parameter Measurements. - A General-Purpose Program for Microwave Network Analysis and Design. Interactive Mode. Specifying Network Elements. Defining Substrate Parameters of MIC (Microwave Integrated Circuit). Microstrip Substrate Parameters. Defining Connections Between Ports of Network Elements. Specifying a Set of Frequencies. Creating and Using Library Block. Optimizing Circuits and Defining Optimization Goals. Specifying the Output Functions. Specifying Data Common to All Network Elements.
Course Objectives	To teach computer aided analysing, modelling, and designing of microwave systems by using the wave approach.
Course Outcomes (The knowledge and the skills that the student will gain at the end of the course)	To gain the abilities and knowledges about analysing, modelling, and designing of microwave systems and similar engineering problems with the aid of computer techniques. To provide abilities producing new techniques. The lecture may be recommended to the person who is intending to contribute on RF area.

Textbook	Lecture Notes on Computer-Aided Analysis, Modeling, and Design Essentials of Microwave Networks by The Computational Wave Approach, T. ŞENGÖR (unpublished). Photocopies are available for the attandees of the lecture.
Additional References	1) Janusz A. Dobrowolski and Wojciech Ostrowski, Computer-Aided Analysis, Modeling, and Design of Microwave Networks- The Wave Approach, Artech House, Boston, Usa, 1996.
Prerequisite Courses	
Prerequisite Subjects	Topics of Electromagnetic Field Theory, Electromagnetic Wave Theory, Antennas and Microwave Lab., Circuits and Systems Analysis, and Designing Microwave Circuits by Exact Synthesis.
Homework/Project	
Laboratory	
Computer Applications	
Additional Practices	

Course Evaluation Criteria

	Number	**Effective Proportion %**
Midterm Exams	2	54
Quiz		
Homework		
Term Projects	1	3
Term Papers		

	Laboratory		
	Other (Answers to the questions directed to the class during the lecture)		3
	Final Exam	1	40

WEEKLY COURSE PLAN

Week	Subject
1	Wave-Based Representation of Microwave Networks. Scattering Matrix Representation. Physical Interpretation of Scattering Parameters. Two-Port-to-Three-Port Scattering Matrix Transformation.
2	Scattering Matrices of an Embedded Multiport Network.
3	Frequency Domain Analysis of Microwave Networks Using Wave Computation. Connection Scattering Matrix Method. Computation of Network Response Functions.
4	Overall Scattering Parameters. Noise Analysis of Microwave Networks Using Noise Waves.
5	Noise Wave Representation of Noisy Microwave Networks. Other Noise Representations of Noisy Networks and Their Transformations to Noise Wave Parameters. Noise Wave Correlation Matrices of Embedded Multiport Networks.
6	Noise Analysis of Arbitrary Topology Linear Multiport Networks. The Algorithm For Noise Figure Computation.
7	Microwave Network Sensitivity Analysis Using the Wave Approach. Transposed Matrix Method for Sensitivity Analysis. Group Delay Computation of Microwave Network Transmission Functions. Midterm Exam.
8	Sensitivity Computation of the Overall Scattering Parameters. Solution of Systems of Circuit Equations Using Sparse Matrix Techniques.
9	Bi-Factorization. Computation of the Solution Vector. Implementation of Sparse Matrix Techniques for Microwave Network Equations With Wave Variables.
10	Microwave Network Optimization Techniques. Definition of Microwave Network Optimization Problem. Generalized l_p Objective Function. Constraints on Optimized Network Parameters.
11	Time Domain Microwave Network Analysis Using Waves and Frequency Domain Data. Time Domain Network Analysis Using Waves. Midterm Exam.
12	Nonlinear Microwave Network Analysis Using Waves. Linear and Nonlinear Subnetworks. Parametric Description of Nonlinear Devices. Harmonic Balance Method.
13	Noise Wave Parameter Measurements. Microwave Six-Port Noise Wave Parameter Analyzer. Interferometer System for Noise Wave Parameter Measurements.
14	A General-Purpose Program for Microwave Network Analysis and Design. Interactive Mode. Specifying Network Elements. Defining Substrate Parameters of MIC (Microwave Integrated Circuit). Excuse Exam.
15	Microstrip Substrate Parameters. Defining Connections Between Ports of Network Elements. Specifying a Set of Frequencies. Creating and Using Library Block. Optimizing Circuits and Defining Optimization Goals. Specifying the Output Functions. Specifying Data Common to All Network Elements.

Course Outcomes

	The objective knowledge and abilities earned by the student with the Electronics and Communications Engineering Department Program	**1**	**2**	**3**
1	Ability to apply knowledge of natural science and engineering			X
2	Ability to design and conduct experiments, as well as to analyze and interpret data			X
3	Ability to design a system		X	
4	Ability to function as a team member		X	
5	Ability to identify, formulate, and solve engineering problems			X
6	Understanding of professional and ethical responsibility			X
7	Ability to communicate effectively			X
8	Knowledge of the impact of the profession in a global and social context			X
9	Recognition of the need for life-long learning			X
10	Knowledge of contemporary issues			X
11	Ability to use modern engineering tools and the techniques			X
12	Providing the opportunity to the student gain more detailed knowledge of chosen research subject in electronics and communications engineering and to apply it.			X

Contribution of the course: **1:** None, **2:** Partial, **3:** Full.