Syrian Arab Republic		**الجمهورية العربية السورية**
Ministry of Higher Education		**وزارة التعليم العالـــي**
Syrian Virtual University		**الجامعة الافتراضية السورية**

Microwave Engineering Course Definition File

1- Basic Information:

Course Name	Microwave Engineering
Course ID	CRF403
Contact Hours (Registered Sessions)	30
Contact Hours (Synchronized Sessions)	18
Mid Term Exam	There is not
Exam	1.5
Registered Sessions Work Load	30
Synchronized Session Work Load	18
Credit Hours	5

2- Pre-Requisites:

Course	**ID**
Electromagnetic Waves and Transmission Lines	CRF301

3- Course General Objectives:

This course will enable students to identify structures and types of microwave circuits/networks and their functionalities, using the scattering matrix [S]. Then this course will expose students to the applications of these techniques for understanding the function of various microwave circuit types including impedance matching, resonators, 3-port power dividers, 4-port directional couplers, and filters, by applying the theory and techniques learned previously to practical problems in microwave engineering.

4- Intended Learning Outcomes (ILO):

Code	Intended Learning Outcomes
ILO1	Comprehension of design challenges at high frequencies
ILO2	Understanding the scattering matrix [S], interpretation of the physical meaning of its S-parameters, and performing methods of evaluation and measurement of S-parameters
ILO3	Identifying some typical transmission line discontinuities and transitions, their equivalent circuits, and incorporating its effect into the design of the network
ILO4	Understanding the Smith chart and its application to design different types of impedance matching networks
ILO5	Identifying common passive microwave circuits (resonators, power dividers, directional couplers, filters), and knowledge of their properties, function, implementation technologies, and practical applications
ILO6	Using of simulation software to understand the principle of different types of microwave circuits/networks

5- Course Syllabus (18 hours of total synchronized sessions)

- **RS:** Recorded Sessions**; SS:** Synchronized Sessions**;**

ILO	Course Syllabus	RS	SS	Type	Additional Notes
ILO1	**General introduction:** • Particularity of microwaves and its applications • Review of techniques of electrical circuits analysis and why these techniques cannot be directly applied to microwave circuits	2	0	☐ Exercises ☐ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	
ILO2 ILO6	**Microwave network analysis using the scattering matrix [S]:** • The concept of scattering matrix [S] and its physical meaning • Microwave circuit properties in terms of [S] matrix properties	8	4.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☒ Practices ☐ Others	S-parameters evaluation of microwave circuits with different terminations, and find out their properties. Learning about using simulation software of microwave circuits.
ILO1 ILO3 ILO6	**Transmission line discontinuities and transitions:** • Types • Effects and compensation • Equivalent circuits for the discontinuities and transitions	1	1.5	☐ Exercises ☐ Assignments ☐ Seminars ☐ Projects ☒ Practices ☐ Others	Use simulation software of microwave circuits to show different types of discontinuities inplanar transmission lines and their effects.
ILO1 ILO3 ILO4 ILO6	**Impedance matching networks design**	6	4.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☒ Practices ☐ Others	Use Smith chart to design different types of impedance matching networks Use simulation software for optimization
ILO1 ILO2 ILO3 ILO5 ILO6	**Power dividers and directional couplers:** • Types, • Properties and function, • Implementation technologies, • Practical applications	5	3	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☒ Practices ☐ Others	Practical problem solving showing the applications of power dividers and directional couplers Use simulation software for optimization
ILO1 ILO2 ILO3 ILO5	**Microwave resonators:** • Types, • Properties and function, • Implementation technologies,	3	1.5	☒ Exercises ☐ Assignments ☐ Seminars ☐ Projects	Apply evaluation methods of resonator quality factor

	• Practical applications			☐ Practices ☐ Others	
ILO1 ILO2 ILO3 ILO5 ILO6	**Microwave filters:** • Types, • Filter response • Design formulas, • Implementation technologies, • Practical applications	5	3	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Apply design techniques to some typical filters Find the filter response using a simulation software

6- Assessment Criteria (Related to ILOs)

ISC	Interactive Synchronized Collaboration		Ex	Exams		Rpt	Reports
PF2F	Presentations and Face-to-Face Assessments		PW	Practice Work			

ILO Code	ILO	Intended Results	Assessment Type				
			ISC	PW	Ex	PF2F	Rpt
ILO1	Comprehension of design challenges at high frequencies		X	X	X	X	X
ILO2	Understanding of the scattering matrix [S], interpretation of the physical meaning of its S-parameters, and performing methods of evaluation and measurement of S-parameters	Understanding of the scattering matrix	X		X		
		Interpretation of the physical meaning of S-parameters	X	X	X		
		Performing methods of evaluation and measurement	X	X	X	X	X
ILO3	Identifying of some typical discontinuities and transitions and their equivalent circuits, and incorporating its effect into the design of the network		X	X	X	X	X
ILO4	Understanding of the Smith chart and its application to design different types of impedance matching networks		X	X	X		
ILO5	Identifying of common passive microwave circuits, and knowledge of their properties, functions, implementation technologies, and practical	Knowledge of their properties and functions	X		X	X	X
		Knowledge of their implementation		X	X		

	applications	technologies, and practical applications					
		Knowledge of technology properties of MMICs	X	X			
		Perfection of datasheet reading	X	X	X		
ILO6	Using of simulation software to understand the principle of different types of microwave circuits/networks		X	X		X	X

7- Practice Tools:

Tool Name	Description
Microwave Office/ Other simulation software	Software tool for high frequency and microwave circuit/electromagnetic simulation for helping circuit design and analysis, understanding circuit functionality, visualizing electromagnetic field distribution on the structure, and find some terminal quantities relating circuit terminals.
Visualization tools	Smith Chart

8- Main References

1- "Microwave Engineering", 4th edition, by David Pozar, Wiley, 2012

9- Additional References

2- "Microwave filters, Impedance-matching networks, and coupling structures", by George Matthaei, Leo Young, E.M.T. Jones, Artech House, 1980

3- "Practical Microwaves", by Thomas Laverghetta, Prentice-Hall, 1995