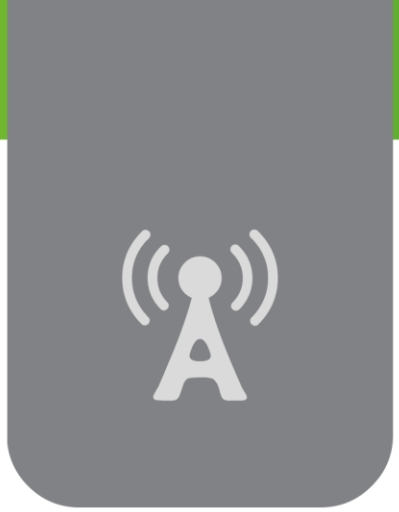

Electromagnetic Waves and Transmission Lines

Course Definition File

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

1. Basic Information:

Course Name	Electromagnetic Waves and Transmission Lines
Course ID	CRF301
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
Electrical Circuits	CEE101

3. Course General Objectives:

This course will enable students understanding time-varying electromagnetic fields and electromagnetic waves, and wave propagation phenomena, which are of essential importance in modern communications. The course focuses on the fundamental concepts of electromagnetic theory that are presented by the general form of time-varying Maxwell's equations, physical significance of these equations, how fields are related, and how are they related to the medium properties. Students will be able to apply boundary conditions for fields at the interface of two different media, to use wave equation to find solutions to Maxwell's equations, and especially, to study plane wave properties and characteristics as a solution, and medium properties of different types: dielectric (lossless and lossy), conductor and perfect conductor. Students will be able to understanding wave propagation mechanisms at interfaces, Poynting theorem and power and energy considerations, and the concept of stored energy and radiated power.

This course will also provide students with the basic theory of transmission lines, and focuses on the basic properties of the most commonly used transmission lines and waveguides and their relative advantages in a broader context. Students will be able to understanding the key differences between circuit theory and transmission line theory.

4. Intended Learning Outcomes (ILO):

Code	Intended Learning Outcomes
ILO1	Understanding time-varying electromagnetic fields and electromagnetic waves.
ILO2	List Maxwell's equations, identifying the plane wave as a solution of Maxwell's equations, and understanding of general electromagnetic wave propagation phenomena.
ILO3	Interpreting of the dielectric and magnetic properties of given materials, and listing the constitutive relations that relate the electromagnetic fields in that material.
ILO4	Applying the boundary conditions for electric and magnetic fields at different interfaces.
ILO5	Understanding Poynting theorem and its application to find received power and power loss
ILO6	Comprehension of the key differences between circuit theory and transmission line theory.
ILO7	Identifying the transmission line as an element in a circuit, naming its parameters, and using Smith chart to solve transmission line problems.
ILO8	Identifying various types of transmission lines and waveguides, their performance, characteristics, and practical applications.
ILO9	Comprehension of the maximum power transfer, and identifying different types of power in aa electrical circuit with transmission line.

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

- RS: Recorded Sessions; SS: Synchronized Sessions;

ILO	Course Syllabus	RS	SS	Type	Additional Notes
ILO1	Review vector calculus and analysis and useful theorems	4		☒ Exercises ☐ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Subjects to be reviewed by student before studying this course
ILO2	Understanding electromagnetic fields and radiation without equations	3	1.5	☐ Exercises ☐ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Identifying reactive and radiated electromagnetic fields without Maxwell's equations which is the basis of electromagnetic theory
ILO1 ILO2 ILO3 ILO6	Electromagnetic theory: • The need for electromagnetics and the concept of electrical length • Electromagnetic spectrum • Static and time-varying fields • Material media • Traveling waves • Maxwell's equations • Conclusion on electromagnetic theory and	6	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Identifying electromagnetic spectrum, time-varying fields, Maxwell's equations and their physical significance

	circuit theory				
ILO1 ILO2 ILO3	Wave propagation • Wave equation • plane wave • plane wave polarization • plane wave in free-space	2	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	solutions to the wave equation, in free-space or in any medium. Find out plane wave properties.
ILO3 ILO4	Material media: • Study of their properties in terms of permittivity and permeability, and write the constitutive relations • Apply the boundary conditions at the interface between two different media	2	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Find the form of permittivity and permeability of some types of material properties, and the skin depth of a good conductor at higher frequencies
ILO2 ILO3 ILO4 ILO5	Poynting's theorem • Poynting's vector definition • Power balance equation • Radiated power and loss	1	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Apply Poynting theorem to find power received and loss
ILO2 ILO3 ILO4	Electromagnetic wave propagation in different media: • Reflection and transmission, • Losses in a material media	2	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Apply boundary conditions at interfaces, to find reflection and transmission coefficients, loss and received power
ILO6	Transmission line as a distributed	2	1.5	☐ Exercises	There is not

ILO7	element in an electric circuit in terms of its parameters			☐ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	
ILO6 ILO7	Network and/or transmission line theory approach to analyze the behavior of the entire system of components, including transmission lines	2	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Apply wave propagation concept to a transmission line in a network
ILO7	Smith chart for solving transmission line problems	3	3	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Exercises using Smith chart for solving transmission line problems
ILO9	Maximum power transfer theorem	1	1.5	☒ Exercises ☐ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Find different power forms in a transmission line circuit
ILO1 ILO3 ILO4 ILO7	Basic properties of common transmission lines and waveguides: • Waveguide • Coaxial cable • Planar transmission lines	2	1.5	☒ Exercises ☒ Assignments ☐ Seminars ☐ Projects ☐ Practices ☐ Others	Find out transmission lines and waveguides parameters in terms of their geometric and physical structures

					Choose the suitable transmission line for a specific application

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	Understanding time-varying electromagnetic fields and electromagnetic waves.		X				
ILO2	Listing Maxwell's equations, identifying the plane wave as a solution of Maxwell's equations, and understanding general electromagnetic wave propagation	List Maxwell's equations	X		X		
		identifying the plane wave solutions	X	X	X		
		understanding electromagnetic wave propagation	X		X	X	
ILO3	Interpreting the dielectric and magnetic properties of materials, and listing constitutive relations that relate the electromagnetic fields in that material		X	X	X	X	X

ILO4	Applying boundary conditions for electric and magnetic fields at different interfaces		X	X	X	X	X
ILO5	Understanding Poynting theorem and its application to find received power and power loss	Understanding Poynting's theorem	X		X		
		Find received power and power loss	X	X	X	X	X
ILO6	Comprehension of the key differences between circuit theory and transmission line theory		X		X		
ILO7	Identifying the transmission line as an element in a circuit, naming its parameters, and using Smith chart to solve transmission line problems	Identifying the transmission line as an element in a circuit and naming its parameters	X		X		
		using Smith chart to solve transmission line problems	X	X	X	X	X
ILO8	Identifying various types of transmission lines and waveguides, their performance, characteristics, and practical applications	Identifying types and characteristics of transmission lines and waveguides	X		X		
		Identifying practical applications of transmission lines	X	X	X	X	X

		and waveguides					
ILO9	Comprehension of the maximum power transfer, and identifying different types of power in aa electrical circuit with transmission line.		X		X		

7. Practice Tools:

Tool Name	Description
Visualization tools	Smith Chart

8. Main Reference

1. "Microwave Engineering", 4th edition, by David Pozar, Wiley, 2012
2. 'Engineering Electromagnetics', 7th Edition, by William Hayt and John Buck, McGraw-Hill, 2006

9. Additional References

1. 'Advanced Engineering Electromagnetics', 2nd Edition, by Constantine A. Balanis, Wiley, 2012
2. 'Fundamentals of Applied Electromagnetics', 6th edition, by Fawwaz T. Ulaby, Eric Michielssen, and Umberto Ravaioli, Pearson, 2010