EE6601: TOPICS IN RADIO FREQUENCY CIRCUIT DESIGN AND APPLICATIONS

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Topics in Radio Frequency Circuit Design and Applications

Subject Code
EE - Electrical Engineering
Course Number
6601

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
EE4106 Radio Frequency and Microwave Techniques or EE4107 Foundations for Microwave Solid State Circuits or electromagnetics related courses.

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to provide students with the fundamental of RF circuit design, together with design concept for various applications.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand basic concepts of RF circuitry.		x	x	
2	Capability for key RF components design		x	x	
3	Understand various RF systems for different applications		x	x	
4	Experimental skills for RF technology		x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Explain key concepts in radio frequency circuit design and applications	1, 2, 3, 4	3 hrs/wk(Some of the lectures in the form of tutorials will be conducted in the laboratory. Nominally 12 hours are laboratory sessions)
2	Tutorial	Explain key concepts in radio frequency circuit design and applications	1, 2, 3, 4	
3	Mini-project	Conduct projects on radio frequency circuit design and applications	1, 2, 3, 4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	30	
2	# Assignments (min.: 3)	1, 2, 3, 4	20	

Continuous Assessment (%)

50

Examination (%)
50

Examination Duration (Hours)
2

Additional Information for ATs
Remark: To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

Assessment Rubrics (AR)

Assessment Task
Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 1 The student will acquire an ability to describe current and anticipated trends in RF circuit design through an overview of the field as well as an in depth understanding of selected topics through lectures, tutorials, assignments and mini-projects.

PILO 2 The student will be able to evaluate and analyze new technologies in RF circuit through an understanding of the performance and current industrial applications through lectures, tutorials, assignments and mini-projects.

PILO 3 The student will be able to apply related course knowledge in the mini-projects.

PILO 4 The student will be able to assess, evaluate and formulate solutions to problems or specifications in RF circuit through theoretical and practical knowledge learnt from lectures, tutorials, assignments and mini-projects

Part III Other Information

Keyword Syllabus

Review of basic RF/microwave theory and techniques

Transmission line theory, s-parameters, passive components, low noise amplifiers amplifiers, power amplifiers and oscillators. RF transceiver topologies wireless communications and standards

Modern transistor technology

BJTs FETs Si, Ge, SiC, GaAs, InP and GaN.

Advanced amplifier design

Power amplifiers, principles of high efficiency power amplifiers, different modes of operation, different topologies such as Doherty and Chireix.

Applications in wireless systems

RFID, NFC, Bluetooth, WiFi wireless power transmission.

Radio frequency integrated circuit and MMIC

Technology and key components in integrated circuits/MMIC basic RF circuits and system on modern semiconductor substrates trends and challenges.

Reading List

Compulsory Readings

	Title
1	Lecture notes

Additional Readings

	Title
1	David Pozar: Microwave Engineering (Addison Wesley, New York, 2nd Edition, 1990)
2	Tianjia Sun, Xiang Xie, and Zhihua Wang: Wireless Power Transfer for Medical Microsystems (New York, NY : Springer New York : Imprint: Springer, 2013)
3	Alison R. McAdams: Radio frequency identification (New York: Nova Science Publishers, c2011)
4	Javier Lopez and Jianying Zhou: Wireless sensor network security (Amsterdam; Washington, D.C. IOS Press, c2008)
5	Boris A. Atayants: Precision FMCW short-range radar for industrial applications (Boston: Artech House, c2014)
6	Caverly, Robert: CMOS RFIC design principles (London: Artech House, c2007)
7	Andrei Grebennikov: RF and microwave power amplifier design (New York : McGraw-Hill, c2005)
8	Reinhold Lidwig and Pavel Bretchiko: RF Circuit Design - Theory and Applications (Prentice Hall, New Jersey, 2000)
9	T C Edwards and M Steer: Foundations of Interconnect and Microstrip Design (John Wiley, New York, 3rd Edition, 2000)
10	Mathew M Radmanesh: Radio Frequency and Microwave Electronics (Prentice Hall, 2001)
11	Robert S Elliott: An Introduction to Guided Waves and Microwave Circuits (Prentice Hall, New York, 1993)
12	K Chang: RF and Wireless Systems (John Wiley, New York, 2000)
13	W A Davis and K K Agarwal: Radio Frequency Circuit Design (John Wiley, New York, 2001)