City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A 2022/2023

Part I Course Overview

Course Title:	Radio Frequency (RF) Circuit Engineering
Course Code:	EE6426
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	EE5425 Fundamentals of Radio Frequency (RF) Circuit Engineering; or EE6425 Fundamentals of Radio Frequency (RF) Circuit Engineering; or equivalent
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to acquire the fundamental concepts, basic theory of advanced circuit design and important techniques in radio frequency circuits.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Design of RF receivers and transmitters.		✓	✓	✓
2.	Understand the basics of large-signal concept and non-linear operation.		✓		
3.	Design of high power amplifier systems, oscillators and mixers.		✓	✓	✓
4.	Apply measurement techniques to large signal devices.		✓	✓	✓
		100%			

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lecture	Key concepts of RF receivers and transmitters, large signal amplifier, oscillator, and non-linear RF circuits and applications are illustrated.	✓	✓	✓	✓			2 hrs/wk
Tutorial	Concepts of RF circuits are worked out based on questions and problem solving.	✓	✓	✓	✓			1hr/wk (*Some of the tutorials will be conducted in the laboratory)*
Mini-Project	Apply the key concepts of the RF circuits and discover new RF circuit design.	✓		✓	✓			

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4				
Continuous Assessment: 50%								
Tests (min.: 2)	✓	✓	✓	✓			30%	
# Assignments (min.: 3)	✓	✓	✓	✓			20%	
Examination: 50% (duration: 2hrs, if applicable)								
Examination	✓	✓	✓	✓			50%	
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in continuous assessment and 30% in the examination.

include homework, tutorial exercise, mini-project development, presentation, demonstration, project report

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

6. Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1,2,3, 4	The course provides students opportunities in acquiring knowledge of and evaluation of RF circuit design, and also the applications of basic concept and skills for RF engineering problem solving.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

RF Receiver and Transmitter
RF receiving system, design consideration and examples.
RF transmitting system, design consideration and examples.
Heterodyne and zero-IF systems, Basic measurement for transmission and reception.

Large Signal Amplifier
Classes of operation and their characteristics.
Design considerations of power amplifier.
Efficiency enhancement.
Large signal scattering parameters and measurement.

Oscillator
Theory of oscillation.
Oscillator design, VCOs.
Frequency stabilised oscillator.

Non-linear RF Circuits and applications
Passive and active mixers.
Passive and active detectors.
Frequency multiplication.
Frequency up-conversion and down-conversion.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Reinhold Ludwig & Pavel Bretchko: RF Circuit Design, (Prentice Hall)
2.	G Vendelin, A Pavio& U Rohde : Microwave Circuit Design Using Linear and Nonlinear Techniques, (John Wiley & Sons, 1990)
3,	Herbert L Krauss, Charles W Bostian& Frederick H Raab: Solid State Radio Engineering, (John Wiley & Sons, 1980)
4.	Ravender Goyal, : High-Frequency Analogue Integrated Circuit Design (John Wiley & Sons, Inc., 1995)

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Christian Gantili : Microwave Amplifiers and Oscillators, (North Oxford Academic, 1986)
2.	Irving M & Gottlieb P E :Solid-State High-Frequency Power, (Reston Publishing Co. Inc. A Prentice-Hall Co., 1982)
3.	Stephen Maas : Microwave Mixers, (Artech House, 1988)
4.	Stephen Maas : Non-linear Microwave Circuits, (Artech House, 1988)
5.	Gary M Miller : Modern Electronic Communication, (Prentice-Hall, 1988)
6.	K Clark & D Hess : Communication Circuit Analysis and Design, (Addison-Wesley, 1971)
7.	Stephen Erst : Receiving Systems Design, (Artech House, 1984)
8.	Ferenc Kovacs : High Frequency Application of Semiconductor Devices, (Elsevier Scientific Publishing Co, 1981)
9.	R S Carson : High Frequency Amplifiers, (Wiley, 1982)
10.	G Vendelin : Design of Amplifiers and Oscillators by the S parameter Method, (Wiley, 1982)
11.	K Chang : Hand book of Microwave and Optical Components, vol. 1, (Wiley, 1990)
12.	Morris Engelson : Modern Spectrum Analyser Theory and application, (Artech House, 1984)