City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A in 2024/2025

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.	Able to apply basic linear and non-linear techniques to RF circuits.		✓	✓	
2.	Able to differentiate between non-linear modes of operation.		✓	✓	
3.	Able to design modern power amplifiers, oscillators and mixers.		✓	✓	✓
4.	Able to 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 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.

3. Learning and Teaching Activities (LTAs)

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

LTA	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 will be illustrated in part. Students will be engaged with the solution to the remaining parts of the illustration leading to problems for students to discover through self-learning after class.	✓	✓	✓				2 hrs/wk
Tutorial	Students will be given problems to solve in the lectures. Between lectures and tutorials, students will find ways to solve these problems so that in the tutorials, they will present and discuss their solutions.	✓	✓	✓				1hr/wk (*Some of the tutorials will be conducted in the laboratory)*
Mini-Project	Students will be formed into small groups to design a circuit to a given specification. Students will assign themselves different tasks to work separately and together as a group. They will be challenged to aim for the best performance using their creativity in 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 before Semester A 2022/23 and in Semester A 2024/25 & thereafter

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

Applicable to students admitted in Semester A 2022/23 to Summer Term 2024

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

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)