City University of Hong Kong

Information on a Course offered by Department of Electronic Engineering with effect from Semester B 2012/13

Part I

Course Title: Fundamental of Radio Frequency (RF) Circuit Engineering

Course Code: EE5425

Course Duration: One semester (13 weeks)

No. of credits: 3

Level: P5

Medium of Instruction: English

Prerequisites *:* Nil

Precursors *:* EE3109 Applied Electromagnetics; or equivalent

Equivalent Course *:* EE6425 Fundamental of Radio Frequency (RF) Circuit Engineering

Exclusive Courses: Nil

Part II

Course Aims:

This course aims to provide students with essential circuit design and measurement techniques in wireless communication devices and radio frequency applications.

Course Intended Learning Outcomes (CILOs)
Upon successful completion of this course, students should be able to:

No.	CILOs
1.	Recognize general knowledge of RF and wireless circuits
2.	Apply S-parameters, transmission line theory, and Smith chart for both impedance matching and DC biasing networks
3.	Extract equivalent circuit models of both transistors and lumped elements
4.	Design small signal RF amplifiers with considerations of stability, gain, and noise factors
5	Apply relevant skills for microwave circuit simulation, design, fabrication, and measurement

Teaching and Learning Activities (TLAs)

(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)

CILO 1	Lectures
CILO 2, 3, 4	Lectures, assignments, tests
CILO 5	Laboratory, mini-project

Timetabling Information

Pattern	**Hours**
Lecture:	39*
Tutorials:	
Laboratory:	
Other activities:	

**Some of the lectures will be conducted in the laboratory.*

Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

	Type of assessment tasks	*Weighting (if applicable)*
Continuous Assessment	Assignments, Tests and Lab Work	50%
Examination	Written exam	50% 2 hours

Remarks: To pass the course, students are required to achieve at least 35% in course work and 35% in the examination. Also, 75% laboratory attendance rate must be obtained.

Grading of Student Achievement:

Refer to Grading of Courses in the Academic Regulations for Taught Postgraduate Degrees.

Letter Grade	**Grade Point**	**Grade Definitions**
A+ A A-	4.3 4.0 3.7	Excellent
B+ B B-	3.3 3.0 2.7	Good
C+ C C-	2.3 2.0 1.7	Adequate
D	1.0	Marginal
F	0.0	Failure

Constructive Alignment with Programme Outcomes

PILO	**How the course contribute to the specific PILO(s)**
1	The course provides students with general knowledge about microwave and wireless communications.
2,3	Students are required to complete an assignment designed to gain practical experience in transmission line theory, S-parameter, Smith chart, and impedance matching. A mid term test will be arranged with PILO 4 to help the student to check their grasp of the knowledge

4	Students are required to complete 4 assignments designed to gain practical experience in design of a low noise amplifier considering stability, gain and noise factors. A mid term test will be arranged with PILO2 and 3 to help the student to check their grasp of the knowledge
5	A min-project is designed for the student to do simulation, design, fabrication, and measurement for a RF amplifier through a mini-project

Part III

Keyword Syllabus:

Syllabus:

Introduction to Radio Frequency (RF) Engineering
Review of fundamental issues of RF engineering
Key existing applications
Issues related to industry

Basic Skill for RF Engineering
S-parameters and mixed-mode S-parameters for multi-port networks
Modelling of various passive elements such as resistor, capacitor, inductor, via, ..
Modelling of bipolar junction transistor and field effect transistors
Impedance matching techniques

Classic Design of Small Signal RF Amplifier
"Performance" circles on Smith charts
Basing circuits and stabilized circuits
General purpose amplifier
Low noise amplifier
Differential amplifier

Experimental Skills
Amplifier design based on CAD tools
Amplifier realization in laboratory
Circuit tuning
Measurement skill including uses of vector network analyzer and noise figure analyzer

Teaching Methods:

Teaching will be conducted in 3-hour sessions, which are in the form of combined lecture, tutorial, and laboratory sessions. The laboratory support shall consist of four 3-hour sessions on topics of RF circuitry.

Recommended Reading:

Essential Reading

R. Ludwig, and & P. Bretchko: RF Circuit Design, (Prentice Hall)

D. K. Cheng: Field and Wave Electromagnetics, (Addison-Wesley, 1989)

W. K. Chen: Broadband Matching - Theory and Implementations, (World Scientific, 1988)

T. T. Ha: Solid-State Microwave Amplifier Design, (John Wiley & Sons 1981)

Guillermo Gonzalez: Microwave Transistor Amplifiers: Analysis and Design, (2nd Edition, Prentice Hall, 1997)

Supplementary Reading

P. C. L. Yip: High-Frequency Circuit Design and Measurements, (Chapman & Hall, 1990)

T. C. Edwards: Fundamentals for Microstrip Circuit Design, (New York, Wiley, 1981)

P. Antognetti, and G. Massobsio: Semiconductor Device Modelling with SPICE, McGraw Hill, 1988)

D. Divekar: FET Modelling for Circuit Simulation, (Kluwer Academic Publishers, 1988)

R. Soares: GaAs MESFET Circuit Design, (Artech House, 1988)

P. H. Ladbrooke: MMIC Design GaAs FET and HEMTs, (Artech House, 1989)

G. Matthaei, L. Young, and E. M. T. Jones: Microwave Filters, Impedance-Matching Networks & Coupling Structures, (Artech House, 1988)

F. Kovacs: High Frequency Application of Semiconductor Devices, (Elsevier Scientific Publishing CO, 1981)

R. S. Carson: High Frequency Amplifiers, (Wiley, 1982)

G. Vendelin: Design of amplifiers and Oscillators by the S-parameter Method, (Wiley, 1982)

H. L. Krauss, C. W. Bostian, F. H. Raab: Solid State Radio Engineering, (John Wiley & Sons, 1980)

K. Chang: Hand book of Microwave and Optical Components, Vol. 1, (Wiley, 1990)

Online Resources (if any)
Nil