

Electrical Engineering Department
King Fahd University of Petroleum & Minerals

Course Number: EE 407
Course Title: Microwave Engineering

Course Description :

Review of Transmission line theory, Planar Transmission lines, Microstrip lines and components, Microwave Network Analysis, Microwave Capacitors, Resistors and Inductors, Microwave Passive Components (Coupler, Power divider, Filter, Circulator, Phase shifter and Patch antenna), Microwave Active Components (Diode, Transistor, Amplifier, Oscillator, Mixer and Demodulator), Introduction to Microwave Integrated Circuits.

Prerequisites :

Electromagnetic Waves (EE 340)

Textbook :

David.M. Pozar, 'Microwave Engineering', 4th Edition, Wiley, 2005, John Wiley & sons, Inc, ISBN 0-471-64451-x

Other useful references and material :

Reference texts: T. Koryo Ishii, *Microwave Engineering*, 2nd Ed., Harcourt and Brace Jovanovich, 1989.

Course objectives:

After successfully completing the course, the students will be able to

- Provide a comprehensive understanding of microwave circuits and the field of microwave engineering
- To be able to analyze and design passive microwave circuit components
- To be able to analyze and design planar microwave active circuit components
- To understand the components of microwave receiver
- Apply and practice the electrical engineering knowledge with professional ethics and safety.

Topics Covered :

- Review of Transmission Line Theory
- Microstrip Transmission lines
- Microstrip components
- Microwave Network Analysis.
- Microwave Passive Components (Capacitors, Resistors, Inductors ..)
- Microwave Passive devices (Power divider, Circulators, Antennas)
- Microwave Materials (Gyrotropic materials)
- Microwave Active Components (Diodes, Transistors..)
- Microwave Active Devices (Amplifiers, Oscillators ..)
- Introduction to Microwave Integrated Circuits (MIC, HMIC, MMIC..).

Class/Laboratory Schedule :

3 lectures per week (50 minutes each) and 3 hours lab per week.

Contribution of course to Meeting the professional component :

The students will learn existing theories related to microwave propagation and active and passive microwave components. The course will emphasize on the use of available CAD tools (from CAEME, HFSS, Microwave Office, ADS, COMSOL-RF module) to aid the design and analysis process. Laboratory projects are designed to promote and strengthen the knowledge acquired in this course. The course project is intended to test the innovativeness, theoretical knowledge and CAD skills of the students. Experimental skills are enhanced by introducing network analyzer measurement techniques.

Relationship of Course to program outcomes

- An ability to formulate and solve RF/microwave propagation related problems using basic knowledge of math, and Electromagnetic theory.
- An ability to design planar RF/microwave passive and active components to meet desired requirements.
- An ability to use CAD tools and network analyzer for basic planar microwave device simulation and testing.

Prepared by Dr. Sheikh Sharif Iqbal, May 20, 2012.

King Fahd University of Petroleum & Minerals
Electical Engineering Department
EE 407-Microwave Engineering (Term 112)

Instructor/coordinator: Dr. Sheikh Sharif Iqbal **Subject :** EE 407-1 **Room:** 59-1015
Office : **Room: 59 – 1075. Tel. 2818** **Email :** sheikhsi@kfupm.edu.sa
Office Hour: **SMW 10:10-10:40 AM** and **UT 10:05-10:50 AM** OR by appointment

TOPICS	Week	DATE	LAB Experiments
Ch 1: Introduction to Microwave Engg; Review of Maxwell's Equation, Plane wave, Guided wave	1	Jan 28 – Feb 1	<i>No lab</i>
Ch 2: Transmission line, Characteristic Impedance, Input impedance, Propagation constant, Reflection/Transmission coefficient	2	February 4–8	<i>Tutorial 1: software packages</i>
Ch 2: Power flow, Standing wave ratio, Impedance transformation.	3	February 11–15	<i>Tutorial 2: software packages</i>
Ch 2: $\lambda/2$ and $\lambda/4$ Impedance transformers, Smith Chart and its applications	4	February 18–22	1: Introduction to software package: CAEME
Ch 2: Impedance Matching network Single Stub matching (series and parallel) Problems - - - -	5	February 25–29	2: Transmission line analysis using 'CAEME' software
Ch 3: Planar Transmission lines (PP W/G, Striplines, Microstrips, Slotline, Coplanar lines etc); Characteristic of Microstrip line, Coupled Microstrip, Microstrip Components (Bends, Elbows, etc), Ch 4: S-Parameters, Two port microstrip network	6	March 3 - 7	3: Measurement of return loss, reflection coefficient and VSWR of microstrip circuit
** Introduction to passive microstrip components (capacitors, resistors, inductors) Ch 8: Microstrip Filters	7	March 10 – 14	4: Transmission line Stub matching using 'CAEME' software
<i>Mid semester Break (April 14 – 15)</i>			
Ch 6: Microstrip resonators Ch 7: Microstrip Directional coupler Microstrip patch antennas...	8	March 17 – 21 (Exam 1=Mar 17)	5: Impedance measurements and microstrip matching networks
<i>Microstrip Power divider (wilkinson, Rat- race etc). Ch 9: Microwave ferrite materials</i>	9	March 31 – April 4	<i>Tutorial 3: software packages</i>
Microwave ferrite circulators, phase shifters Ch 10: Microwave semiconductor devices Microwave Diodes.. Schottky, Pin Varactor..	10	April 7 - 11	6: Insertion loss characteristics of microstrip low pass filter
Ch 11: Microwave Transistors, MOSFET, JFET, MESFET, HEMT... Microwave amplifiers: Biasing techniques	11	April 14 – 18	7: Properties of a microstrip directional coupler
Amplifier Matching networks, Gain, Stability, Noise figure ...	12	April 21 – 25	8: Properties of a Wilkinson power divider and hybrid ring coupler
Ch 11: Microwave tubes and oscillators Ch 12: Microwave radio link	13	April 28 – May 2 (Exam2=April 29)	10: DC biasing and microwave amplifiers
Introduction to microwave integrated circuits: MIC, HMIC, MMIC and Review	14	May 5 – May 7	11: Microwave radio link and antennas
	15	May 12 – May 16	<i>Lab final</i>

Textbook: Microwave Engineering by Pozar; **Reference:** Microwave Engg. by P.A. Rizzi & Microwaves by B. Fuller
Grading: Attn./CW/HW =20%, Proj=10%; Major 1=15% ; Major 2=15% ; Final-exam=20% ; Lab=20%

Major Exams: **Exam 1; Saturday; 17th March ; 11:00 - 11:50 AM ; Room: 59-1001**
Exam 2; Monday; 29th April ; 7:30 - 9:00 PM ; Room: 59-1001

Absences: University rules: -- 6 unexcused absences → **Warning** ; -- 9 unexcused absences → **DN.**