CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

# COLLEGE OF ENGINEERING
# COURSE OUTLINE

| ET Major | Course Classification: ET Core | Major Core | Tech Elect | GE | Course Title: Microwave Techniques<br>Course No ETE 438/438L<br>Prepared by: C. Johnson<br>Date of Last Revision: 6/23/99<br>Revised by: G. K. Herder<br>Approved by: |
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| CET<br>ECET<br>ET | | | (3/1) | | |

## I. Course Description

**ETE 438/438L Microwave Techniques (3/1)**

Microwave safety, generation, transmission, wave guides, wave guide components and measurements. Microwave measurement systems and techniques. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: ETE 437.

## II. Required Background of Experience

Background/Knowledge in RF Transmission Line theory and applications (ETE437/437L)

## III. Detailed Description of the Course

A. Expanded Description of the Course

1. RF and Transmission Line Systems Review / Introduction to Microwave Systems (1 week)
2. Smith Chart Matching Solutions, Lumped and Distributed Systems (1 week)
3. Two Port Parameters (Z, Y and S) and High Frequency Applications (1 week)
4. Y and S parameter matching solutions for amplifiers (1 week)
5. Maxwell's equations: Microwave Energy Propagation and Waveguides (2 weeks)
6. Wave Guide Modes, Rectangular, Circular Guides, (1 week)
7. Special Waveguide Components: Types, Couplers, "T"s and Phase Shifters (1 week)
8. Microwave Applications: (2 weeks)
   a. RADAR Systems
   b. Satellite Applications
   c. Terrestrial Applications

B. Methods of instruction and Evaluation

Instruction: Classroom lecture
Evaluation: Periodic exams and quizzes, homework problems, and computer assignments.

C. Expected Outcomes

Upon successful completion of this course, each student will be able to:

1. Understand the application of lumped and distributed components in high-frequency applications.
2. Understand the use of Y parameters in amplifier design
3. Understand the basics of S-parameters and their use in amplifier design.
4. Understand the significance of Maxwell's equations in Microwave waveguide applications.
5. Understand the multi-mode problem in waveguide applications.
6. Understand the significant factors involved in a typical microwave application such as: RADAR, Satellite or Terrestrial Microwave transmission.

D. Minimum Student Materials

Assigned text, calculators, Smith charts, notebook.

E. Minimum University Facilities

Standard classroom for lectures, with black (or white) board and overhead projector with screen.

## IV. Text and References

Text: Instructor-prepared course notes, various Hewlett Packard Application Notes

References: Bowick, Chris, RF Circuit Design, SAMS publications, 1997, ISBN 0-672-21868
Rizzi, Peter A., Microwave Engineering/ Passive Circuits, Prentice Hall, 1992, 0-13-586702-9,

## V. Detailed Description of the laboratory

A. Typical laboratory experiments

1. Network Analyzer applications
2. Matching Solutions using Software and Smith Charts
3. 2-port parameter measurements
4. Waveguide systems assembly and measurements
5. Waveguide measurements: Phase velocity and guide wavelength

B. Methods of instruction and Evaluation

Instruction: Hardware/computer laboratory with students working on equipment under faculty supervision, this may include some lecture, as appropriate. Software confirmation of laboratory solutions maybe completed outside the lab and demonstrated in lab.

Evaluation: Laboratory participation and lab reports.

C. Expected Outcomes

Upon successful completion of this laboratory, each student will be able to:

1. Create matching solutions for lumped (LC) components by calculation and Smith Chart
2. Create matching solutions for distributed components (transmission lines and waveguides) by calculation and Smith Chart
3. Understand the calibration and basic use of the Network Analyzer
4. Understand the proper assembly of waveguide systems
5. Understand basic waveguide measurements

D. Minimum Student Materials

Smith Charts and graphical construction tools, access to an IBM PC, SPICE and Smith Chart software.

E. Minimum University Facilities

Hardware laboratory with RF sources, Standing Wave Indicator, Slotted Line, various RF terminations and connectors. Computers for Transmission Line and Smith Chart software. Access to Network Analyzer including calibration kits.

F. Text and References
Text: Laboratory materials are locally prepared.
Reference: Lecture text(s).

## ECET Course Outline Addendum

**Course Number and Title**: ETE 438/438L Microwave Techniques /Lab (3/1)

**Computer usage:**

Computer Work is designed to support lecture material through homework problems or laboratory work through pre-lab analysis.

Typical assignments include:

1. Use of advanced spreadsheet tools: complex math operators for matching calculations and solutions

2. Use of Smith Chart software for matching calculations and solutions

**Laboratory projects [including major items of equipment and instrumentation used]**

The laboratory equipment required for this lab include: Microwave and RF sources, Standing Wave Indicators, Waveguide slotted line systems with various waveguide terminations and components. Network Analyzer equipment including calibration kits. Laboratory work includes the use of Smith Chart software used for in-lab and outside assignments.

**Oral and written communication requirements [be specific]**

Laboratory reports both summary and formal are the primary written component, oral presentation of laboratory solutions is the typical oral requirement. Written reports are to be word-processed summarizing what was learned from the particular exercise, supported with technical details derived from computer and experimental work.

**Calculus usage [be specific]**

The primary use of calculus in this is in understanding of the Maxwell's Equations and their application to waveguide systems.

**Library usage:**

No direct usage is required in this course and/or laboratory

**Prepared by:** Gerald K. Herder