

## EE 436/ ECG 633—Microwave Engineering

**Instructor:**  
**Office Hrs:** 11:30-1:00 M,W

**Office:**  
**Phone:**

**Text:** David Pozar, *Microwave Engineering*, 4<sup>th</sup> ed., Wiley, 2012.

### Other Texts:

- R.E. Collin, *Foundations for Microwave Engineering*, McGraw-Hill, 1966.
- Matthew N.O. Sadiku, *Elements of Electromagnetics*, 6<sup>th</sup> ed. Oxford, 2015.

**Goals:** *Students will be exposed to different types of microwave devices and theories. Verbiage and definitions used by the microwave engineer will be presented and employed. Students will obtain the background to design simple microwave devices.*

### Prerequisites:

EE 330 and either MATH 432 or MATH 459. All prerequisites must be completed with a grade of C or better. Advanced Standing required.

### Course Logistics:

	<b>Grad.</b>	<b>Undergrad.</b>
Midterm	30%	30%
Final (Full or part Take Home)	35%	35%
Design Project / Labs	15%	30%
Graduate Paper	15%	-
Homework	5%	5%
Total	100%	100%

### Catalog Data:

Waveguides, dispersion diagrams, microwave network analysis, broadband impedance matching, open and closed resonators, power dividers, directional couplers, filters, circulators, phase shifters, introduction to solid state amplifier or oscillator design.

### Topics:

1. Electromagnetic review. Normal and oblique incidence, surface impedance concept, and polarization. (4 lectures) Chapter 1
2. Smith Chart – Hands on use. (2 lectures) Chapter 2
3. Fundamental waveguides: rectangular, cylindrical, parallel plate and microstrip. (7 lectures) Chapter 3
4. Microwave network analysis-basics. (7 lectures) Chapter 4
5. Microwave resonators: rectangular and cylindrical. (4 lectures) Chapter 6
6. Other microwave devices: magic tee, power dividers, couplers, etc. (2 lectures) Chapter 7
7. Laboratory demonstrations. (3 lectures) (With Student Assistance)

## **COURSE OUTCOMES(ABET course outcomes) [UULO course outcomes]**

Upon completion of the course, students will be able to:

- analytically and conceptually understand the fundamental mechanism characterizing planar, rectangular, cylindrical, coaxial, and microstrip waveguides work and their physical limitations (1.1, 1.2, 1.3, 1.6, 1.7, 1.10) [2]
- analytically and conceptually understand the fundamental mechanism characterizing cavities and their physical limitations and applications (1.1, 1.2, 1.3, 1.6, 1.7, 1.10)
- use and read a Smith chart (1.6, 1.10) [2]
- understand and use the S-parameters (scattering parameters) to describe various microwave components (1.2, 1.3, 1.6, 1.7, 1.8, 1.10)
- understand the physical mechanisms behind a number of passive microwave devices allowing one to design a microwave system to transport and/or manipulate the microwave signature (1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 1.10, 1.11) [1,2,3]

## **ABET COURSE OUTCOMES**

1. The appropriate technical knowledge and skills
  - 1.1. An ability to apply mathematics through differential and integral calculus,
  - 1.2. An ability to apply advanced mathematics such as differential equations, linear algebra, complex variables and discrete mathematics,
  - 1.3. An ability to apply knowledge of basic sciences,
  - 1.4. An ability to apply knowledge of computer science
  - 1.5. An ability to apply knowledge of probability and statistics,
  - 1.6. An ability to apply knowledge of engineering
  - 1.7. An ability to design a system, component, or process to meet desired needs within realistic constraints
  - 1.8. An ability to identify, formulate, and solve engineering problems
  - 1.9. An ability to analyze and design complex electrical and electronic devices
  - 1.10. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
  - 1.11. An ability to design and conduct experiments, as well as to analyze and interpret data
2. The appropriate interpersonal skills
  - 2.1. An ability to communicate effectively
  - 2.2. An ability to function on multidisciplinary teams
3. The knowledge and skills to be responsible citizens
  - 3.1. An understanding of professional and ethical responsibility
  - 3.2. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
  - 3.3. A recognition of the need for, and an ability to engage in life-long learning
  - 3.4. A knowledge of contemporary issues
  - 3.5. A knowledge of the basic content and concepts of the U.S. and Nevada constitutions

## **UULO COURSE OUTCOMES**

1. Intellectual Breadth and Lifelong Learning
2. Inquiry and Critical Thinking
3. Communication
4. Global/Multicultural Knowledge and Awareness
5. Citizenship and Ethics

## OTHER UNLV POLICIES

**Academic Misconduct** – Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the Student Academic Misconduct Policy (approved December 9, 2005) located at:  
[http://www.unlv.edu/sites/default/files/page\\_files/27/UNLVStudentConductCode1212016.pdf](http://www.unlv.edu/sites/default/files/page_files/27/UNLVStudentConductCode1212016.pdf).

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**Disability Resource Center (DRC)** – The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702- 895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an Minimum Criteria for Syllabi – Spring 2016 Page 2 of 2 CR/rs/gg revised 1.22.2016 appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

**Religious Holidays Policy** – Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the end of the first two weeks of classes, January 29, 2016, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit:  
<http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

**Incomplete Grades** - The grade of I – Incomplete – can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

**Tutoring** – The Academic Success Center (ASC) provides tutoring and academic assistance for all UNLV students taking UNLV courses. Students are encouraged to stop by the ASC to learn more about subjects offered, tutoring times and other academic resources. The ASC is located across from the Student Services Complex (SSC). Students may learn more about tutoring services by calling 702-895-3177 or visiting the tutoring web site at: <http://academicsuccess.unlv.edu/tutoring/>.

**UNLV Writing Center** – One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>

**Rebelmail** – By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. Emailing within WebCampus is acceptable.

**Final Examinations** – The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.

**Library Resources** - Students may consult <https://www.library.unlv.edu/consultation> with a librarian on research needs. For this class, the subject librarian is Sue Wainscott. ([https://www.library.unlv.edu/contact/librarians\\_by\\_subject](https://www.library.unlv.edu/contact/librarians_by_subject)). UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at <https://www.library.unlv.edu>.