

## *Course Syllabus*

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### **Course Information**

<i>Course Number/Section</i>	EERF 6311-501
<i>Course Title</i>	RF and Microwave Circuits
<i>Term</i>	Fall 2016
<i>Days &amp; Times</i>	M/W 5:30 – 6:45pm
<i>Location</i>	FO 2.404
<i>Website</i>	e-learning.utdallas.edu

### **Instructor Contact Information**

<i>Instructor</i>	Dr. Rashaunda M. Henderson
<i>Office Phone</i>	972-883-6454
<i>Email Address</i>	rashaunda.henderson@utdallas.edu
<i>Office Location</i>	ECSN 4.620
<i>Office Hours</i>	Monday/Wednesday 1 – 2 pm or by appointment
<i>Other Information</i>	Course TA: Haohan Yao
<i>TA Office Hours</i>	TBD

### **Course Pre-requisites, Co-requisites, and/or Other Restrictions**

EE4368 or equivalent

### **Course Description**

This course goes beyond an undergraduate RF course to develop the ability to apply RF design fundamentals to a variety of passive and active microwave circuits. Knowledge of the electromagnetic properties of materials, RF diodes, transistors, the Smith chart, high frequency scattering parameters, transmission line analysis and system level computations will be used to design real-world RF and microwave components. Microwave computer-aided design (CAD) software tools will be employed to enhance the understanding between theory and practical application.

EERF 6311 RF and Microwave Circuits (3 semester hours): Analysis and design of RF and microwave circuits. Topics include impedance matching, network theory, S-parameters, transmission line media (waveguide, coax, microstrip, stripline, coplanar waveguide, etc.) and passive component design (power dividers, couplers, switches, attenuators, phase shifters, etc.). Industry-standard microwave CAD tools will be used.

### **Student Learning Objectives/Outcomes**

#### **Objectives**

Ability to analyze and design various RF transmission line media  
Ability to analyze and design RF matching networks for complex impedances  
Ability to design RF/Microwave passive and active components

### **Required Textbooks and Materials**

#### *Required Texts*

*Microwave Engineering, 4th ed.*, David M. Pozar, John Wiley and Sons, 2011

### **Suggested Course Materials**

Read on-line user tutorials for CAD programs to be used in the class (both available on UT Dallas ECS computers)

Agilent EEsof Advanced Design System (ADS) – student licenses available

OR

Applied Wave Research Microwave Office (MWO) – student licenses available

### **Assignments & Academic Calendar**

*Homework assignments, quizzes and exam dates will be given in class. The final exam date is set by the university. Topics and reading assignments:*

## Chapter 2: Transmission line theory

- 2.1 Lumped-element circuit model
- 2.3 Terminated lossless transmission line
- 2.4 The Smith chart
- 2.5 The quarter-wave transformer
- 2.6 Generator & load mismatches
- 2.7 Lossy transmission lines

## Chapter 3: Transmission lines and waveguides

- 3.1 General solutions for TEM, TE, and TM waves
- 3.3 Rectangular waveguide
- 3.7 Stripline
- 3.8 Microstrip line
- 3.10 Wave velocities & dispersion

## Chapter 4: Microwave network analysis

- 4.1 Impedance and equivalent voltages and currents
- 4.2 Impedance and admittance matrices
- 4.3 The scattering matrix
- 4.4 The transmission (ABCD) matrix

## Chapter 5: Impedance matching and tuning

- 5.1 Matching with lumped elements (L networks)
- 5.2 Single-stub matching
- 5.3 Double-stub matching
- 5.4 The quarter-wave transformer

## Chapter 7: Power dividers and directional couplers

- 7.1 Basic properties of dividers and couplers
- 7.2 The T-junction power divider
- 7.3 The Wilkinson power divider
- 7.5 The quadrature (90°) hybrid
- 7.6 Coupled line directional couplers

## Chapter 8: Microwave filters

- 8.3 Filter design by the insertion loss method
- 8.4 Filter transformations
- 8.6 Stepped-impedance low-pass filters
- 8.7 Coupled line filters

## Chapter 11: Active RF and microwave devices

- 11.1 Diodes and diode circuits

### Grading Policy

Homework assignments	5%
Quizzes	10%
Exams	75%
Final design project	10%

Grades will be assigned as follows:

93-100%	A
90-92%	A-
87-89%	B+
83-86%	B

80-82%	B-
77-79%	C+
73-76%	C
70-72%	C-
60-69%	D
Below 60%	F

### **Course and Instructor Policies**

#### *Make-up exams*

Any request for change of exam schedule due to out-of-town work, religious holiday, etc. must be approved in advance.

#### *Extra Credit & late work*

No extra credit will be given. After one course day, 85% max score, after two course days, not accepted.

#### *Classroom Citizenship*

Professional at all times. Use of mobile phone, PDA or Smartphone is not allowed during class or exam sessions. All such systems must be turned off or silenced and not used during classes and exams without prior permission from the instructor.

### **Comet Creed**

*This creed was voted on by the UTD student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same: “As a Comet, I pledge honesty, integrity, and service in all that I do.”*

### **UT Dallas Syllabus Policies and Procedures**

The information contained in the following link constitutes the University’s policies and procedures segment of the course syllabus. Please go to <http://go.utdallas.edu/syllabus-policies> for these policies.

### **Technical Support**

If you experience any problems with your UTD account you may send an email to: [assist@utdallas.edu](mailto:assist@utdallas.edu) or call the UTD Computer Helpdesk at 972-883-2911. UT Dallas provides eLearning technical support 24 hours a day/7 days a week. The services include a toll free telephone number for immediate assistance (1-866-588-3192), email request service, and an online chat service.

Please use this link to access the UTD eLearning Helpdesk:

<http://www.utdallas.edu/elearning/eLearningHelpdesk.html>.

### **Student Conduct & Discipline**

The University of Texas System (Regents' Rule 50101) and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UT Dallas online catalogs (<http://catalog.utdallas.edu>).

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the Student Code of Conduct, UTDSP5003 (<http://policy.utdallas.edu/utdsp5003>). Copies of these rules and regulations are available to students in the Office of Community Standards and Conduct, where staff members are available to assist students in interpreting the rules and regulations (SSB 4.400, 972-883-6391) and online at <https://www.utdallas.edu/conduct/>.

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents’ Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

### **Academic Integrity**

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic Dishonesty, any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts. Additional information related to academic dishonesty and tips on how to avoid dishonesty may be found here: <https://www.utdallas.edu/conduct/dishonesty/>.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

### **Copyright Notice**

It is the policy of the University of Texas at Dallas to adhere to the requirements of the United States Copyright Law of 1976, as amended, (Title 17, United States Code), including ensuring that the restrictions that apply to the reproduction of software are adhered to and that the bounds of copying permissible under the fair use doctrine are not exceeded. Copying, displaying, reproducing, or distributing copyrighted material may infringe upon the copyright owner's rights. Unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject students to appropriate disciplinary action as well as civil and criminal penalties. Usage of such material is only appropriate when that usage constitutes "fair use" under the Copyright Act. For more information about the fair use exemption, see <http://copyright.lib.utexas.edu/copypol2.html>. As a UT Dallas student, you are required to follow UT Dallas' copyright policy (UTDPP1043 at <http://policy.utdallas.edu/utdpp1043>) and the UT System's policy, UTS107 at <http://www.utsystem.edu/board-of-regents/policy-library/policies/uts107-use-copyrighted-materials>.

### **Email Use**

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. All official student email correspondence will be sent only to a student's UT Dallas email address and UT Dallas will only consider email requests originating from an official UT Dallas student email account. This allows the University to maintain a high degree of confidence in the identity of each individual's corresponding via email and the security of the transmitted information. The University of Texas at Dallas furnishes each student with a free email account that is to be used in all communication with university personnel. The Office of Information Technology provides a method for students to have their UT Dallas mail forwarded to other email accounts. To activate a student UT Dallas computer account and forward email to another account, go to <http://netid.utdallas.edu>.

### **Withdrawal from Class**

The administration at UT Dallas has established deadlines for withdrawal from any course. These dates and times are published in the Comet Calendar (<http://www.utdallas.edu/calendar>) and in the Academic Calendar (<http://www.utdallas.edu/academiccalendar>). It is the student's responsibility to handle withdrawal requirements from any class. In other words, a professor or other instructor cannot drop or withdraw any student unless there is an administrative drop such as the following:

- Have not met the prerequisites for a specific course
- Have not satisfied the academic probationary requirements resulting in suspension
- Office of Community Standards and Conduct request
- Have not made appropriate tuition and fee payments
- Enrollment is in violation of academic policy

- Was not admitted for the term in which they registered

It is the student's responsibility to complete and submit the appropriate forms to the Registrar's Office and ensure that he or she will not receive a final grade of "F" in a course if he or she chooses not to attend the class after being enrolled.

### **Student Grievance Procedures**

Procedures for student grievances are found in university policy UTDSP5005 (<http://policy.utdallas.edu/utdsp5005>). In attempting to resolve any student grievance regarding disputes over grades, application of degree plan, graduation/degree program requirements, and thesis/and dissertation committee, adviser actions and/or decisions, evaluations, and/or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originated.

### **Incomplete Grade Policy**

As per university policy, incomplete grades may be given, at the discretion of the instructor of record for a course, when a student has completed at least 70% of the required course material but cannot complete all requirements by the end of the semester. An incomplete course grade (grade of 'I') must be completed within the time period specified by the instructor, not to exceed eight (8) weeks from the first day of the subsequent long semester. Upon completion of the required work, the symbol 'I' may be converted into a letter grade (A through F). If the grade of Incomplete is not removed by the end of the specified period, it will automatically be changed to F.

### **AccessAbility Services**

It is the policy and practice of The University of Texas at Dallas to make reasonable accommodations for students with properly documented disabilities. However, written notification from the Office of Student AccessAbility (OSA) is required. If you are eligible to receive an accommodation and would like to request it for this course, please discuss it with your professor and allow one week advance notice. Students who have questions about receiving accommodations, or those who have, or think they may have, a disability (mobility, sensory, health, psychological, learning, etc.) are invited to contact OSA for a confidential discussion. OSA is located in the Student Services Building, SSB 3.200. They can be reached by phone at 972-883-2098, or by email at [studentaccess@utdallas.edu](mailto:studentaccess@utdallas.edu).

### **Religious Holy Days**

The University of Texas at Dallas will excuse a student from class or other required activities, including examinations and travel time for the observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, of the Texas Tax Code. Students are encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. Excused students will be allowed to take missed exams or complete assignments within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the President of UT Dallas or from the President's designee. The chief executive officer or designee must take into account the legislative intent of Texas Education Code 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

***The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.***