

University of Massachusetts  
Department of ECE  
Amherst, MA 01003

Course Instructor: **R. Janaswamy**  
Date of Preparation: **01/29/2008**  
Prepared by: **R. Janaswamy**

## **ECE 585: Microwave Engineering II (3-0), Spring 2008**

### **I. Catalog Data**

3-port and 4-port passive devices, power dividers, direction couplers; microwave filters and periodic structures; ferromagnetic components, isolators, circulators, phase shifters; noise and distortion, noise temperature, cascaded systems, dynamic range and intermodulation products; microwave amplifier design, stability, single stage and broadband amplifier design.

### **II. Course Objectives**

(1) To understand the theoretical principles underlying microwave devices and networks, (2) To design microwave components such as power dividers, hybrid junctions, microwave filters, ferrite devices, and single-stage microwave transistor amplifiers, (3) To improve skills in written communication, through a project report, (4) To understand and quantify the effects of noise in microwave systems, and (5) To quantify the signal and noise characteristics of microwave systems such as communication networks, radars, and radiometers, and relate this to the design process.

### **III. Instructor**

[Professor Ramakrishna Janaswamy](#), Marcus Hall Room 215D,  
(413) 545-0937, [janaswamy@ecs.umass.edu](mailto:janaswamy@ecs.umass.edu). Office hours are  
Tu,Th 10:30-11:30 a.m.

### **IV. Prerequisites**

ECE584, Microwave Engineering I or equivalent

### **V. Text**

D. M. Pozar, *Microwave Engineering*, 3<sup>rd</sup> Ed., John Wiley & Sons,  
ISBN 0471-44878-8, 2005.

## V. Teaching Assistant

The TA for this course will be Jie Xu for the first half and Harish Vedantam for the second half. The TAs will be grading homeworks and posting solutions.

## VI. Software

[Ansoft Designer](http://www.ansoft.com/ansoftdesignersv/) may be used for some assigned homework problems in the course. The student version SV can be downloaded for free from <http://www.ansoft.com/ansoftdesignersv/>. Other equivalent microwave CAD software packages may also be used, including HP/Agilent [EESof EDA Microwave Circuit Designer](http://www.keysight.com/eda/microwave-circuit-designer), Optotek [MMICAD](http://www.optotek.com/mmica), and AWR [Microwave Office](http://www.awr.com/mwo).

## VII. Required Background Experience

1. Transmission Line Theory, Smith Chart.
2. Microwave network analysis, scattering and transmission matrices.
3. EM theory, plane waves, waveguides
4. Impedance matching and tuning.
5. Microwave tuners.

## VIII. Detailed Description of the Course

### 1. Course Topics

A. Power Dividers and Couplers, Ch. 7                      5 lecs  
Three-port and four-port parameters, Wilkinson power divider, waveguide and coupled line directional couplers, quadrature hybrid, 180 degrees hybrid, Lange coupler.

B. Microwave Filters: Ch. 8                                      8 lecs  
Periodic structures, image parameter method, insertion loss method, filter transformations, lowpass and bandpass filters.

C. Ferrimagnetic Components: Ch. 9                      4 lecs  
Plane wave propagation in a ferrite medium, ferrite loaded rectangular waveguide, ferrite isolators, ferrite circulators, phase shifters.

D. Noise and Distortion: Ch. 10	4 lecs
Noise in microwave systems, noise figure and noise equivalent temperature, cascaded systems, dynamic range and intermodulation distortion.	
E. Microwave Amplifier Design: Ch. 11	6 lecs
Two port power gains, stability, single-stage amplifier design, broadband transistor amplifier design, power amplifiers.	
F. No class (2/19)	
G. Midterm exams	1 lec
TOTAL	28 lecs

## 2. Method of Instruction and Evaluation

A lecture mode of instruction will be used. One midterm at 40% and a final exam at 45 % are planned for the course. Finals will be comprehensive. Homeworks will be assigned periodically and graded (10%). Class room discussions will constitute 5% of grade. Late homeworks will NOT be accepted.

### IX. Course Web Site:

[www.ecs.umass.edu/ece/janaswamy/ECE585](http://www.ecs.umass.edu/ece/janaswamy/ECE585)

### X. Relationship of course objectives to program outcomes:

For undergraduate majors taking this course, these five objectives are related in part to ten broad capabilities (Program Outcomes) that we expect for all our BS graduates in the EE and CSE programs. These are related as shown in the table below.

Program Outcomes	Course Objectives				
	1	2	3	4	5
1. Well grounded in the fundamental concepts of mathematics, physics, chemistry, computer science, and	N	N	N	N	N

engineering science.					
2. Able to identify, formulate and solve problems in ECE	Y	Y	Y	Y	Y
3. Able to design and conduct experiments, and to analyze and interpret measured data	N	N	N	N	N
4. Capable of designing analog and digital systems, components, and processes to meet desired needs	N	Y	N	N	Y
5. Proficient in using modern engineering techniques and computing tools for engineering practice	N	Y	N	N	N
6. Experience in engineering teamwork and in solving technically diverse problems	N	N	N	N	Y
7. Able to communicate effectively orally and in writing, and through symbolic and graphical expression	N	Y	N	N	N
8. Aware of professional and ethical responsibilities as engineers	N	N	N	N	N
9. Aware of the impact of ECE technology and decisions on society	N	N	N	N	Y
10. Motivated about the importance of lifelong learning and professional development	N	N	N	N	N

**XI. Professional Component:**  
Engineering Science 1 cr, Engineering Design 2 cr.