EEL4420/6658/6935: RF & MICROWAVE MEASUREMENTS- Spring 2009

Text: None – Notes and other material will be made available at Pro Copy, on web page, and put on USF Library Reserve.

Instructor: Dr. L.P. Dunleavy **OFFICE**: ENB373 **Phone:** 974-2574

Lecture Period: TBD **EMAIL:** dunleavy@eng.usf.edu

Lab Periods: **TBD**

Office Hours **TBD** , other times by appointment (email request)

Catalogue Description:
This course provides an understanding of the motivation, theory, and practical applications of a wide range of radio frequency (RF) and microwave measurements. Treatment includes scattering parameter, noise, power, spectrum analysis, and non-linear frequency conversion and distortion measurements.

Prerequisites: Electromagnetics - EEL4472 (Transmission Lines, Electrodynamics, Maxwell's Equations)
Wireless Circuits & Systems Laboratory –ELR 4316L or EEL5136 (also taught in past under EEL 4937/5936)

Courses that require this as a direct prereq.: None

Reference (supplemental reading): To Be Placed on library reserve –

G.H. Bryant, *Principles of Microwave Measurements*, Peter Peregrinus, Ltd. (for IEE), 1988. (TK7876 .B79)
D. Pozar, *Microwave Engineering*, 2nd Ed. John Wiley, 1998 (TK7876 .P69)
G.H. Bryant, *Principles of Microwave Measurements*, Peter Peregrinus, Ltd. (for IEE), 1988. (TK7876 .B79)
H.M. Kanare, *Writing the Laboratory Notebook*, American Chemical Society, 1985.
(Q180.58 .K36)
T.S. Laverghetta, *Handbook of Microwave Testing*, Artech House, 1981

Course Objectives:

1. Students learn transmission line theory in the context of RF & microwave measurement problems.
2. Students learn the concepts and construction of modern RF & microwave instrumentation.
3. Students learn the applications of modern instrumentation to many different types of RF & microwave measurement problems.
4. Students learn to design and conduct experiments and interpret data in the context of modern RF & microwave measurements.
5. Students learn the operational characteristics of many types of RF & microwave components through experimentation with them.
6. Students learn to communicate clearly the results of each of 10-12 laboratory experiments in concise summaries that are well written abstracts for detailed laboratory reports.
7. Students learn the theory behind several different types of linear and non-linear RF & microwave measurement problems, and demonstrate that knowledge in problem solving exercises, quizzes and exams.

Topic	**# Lecture Hours**
Introduction to Radio Frequency and Microwave Measurements	2
Transmission Line and Network Theory	6
Modern signal generators	2
Detectors and Sensors	2
Cables, Connectors, Fixtures and Wafer Probes	2
Vector Network Analysis	2
VNA Calibration and De-Embedding	2
Spectrum Analysis	4
Noise Temperature and Noise Figure	4
Power Measurements	2

Relation of Course to Department ABET Objectives: 1 & 2
Relation of Course to Department ABET Outcomes: a,b,g,h, and e

Distortion and Frequency Translation Measurements	1
Phase Noise Measurements	1
	30

Laboratory Portion: 2 Hours/wk for 14 weeks comprising approximately 10 laboratory assignments. **~# Lab Hours = 20-28.**

Specialization: This elective course is part of a specialization in the area of Wireless and Microwave (WAMI) Circuits and Systems.

Additional Course Features: This course utilizes University of South Florida's well equipped Wireless and Microwave Instructional Laboratory (WAMI Lab). Several instrumentation and test accessory manufacturers also loan supplemental equipment during each course offering.

Assessments:
Homework (not graded) , Weekly Quizzes, Final Exam, Laboratory Reports, Term Project (Extra Credit for Undergrads)

Actions Taken to Improve the Course: The principal instructor is currently writing a book on the subject of this course. The quality of the lectures has been continually improving as a direct result. Experiments and regularly updated, using feedback from each semester's students. Suggestions are also solicited annually from the USF's Wireless and Microwave (WAMI) Program External Advisory Board. To the extent possible these suggestions are incorporated into the course.

Grading:

	EEL4658	EEL6658/6935	Lecture Only Students
Course Credits	3	3	2
Homework	Assigned/Not Graded		
Quizzes	50	50	50
Exams (2)	100	100	100
Labs	100	100	
Term Project*		50	
Total Pts.	250	300	150
Extra Credit*	TBA		

*On-campus lecture/lab graduate students are required to complete a term project, whereas undergraduates and lecture only students may optionally complete a project and receive up to 15 extra credit points. An example project would be to construct and carry out an experiment that, for example, might be used in a future offering of the class, or could lead to the basis for a paper or trade magazine article. The project will consist of a limited literature study, along with planning and execution of a measurement experiment. At least a subset of the measured results achieved should be compared to theory, or a separate measurement method, or both. Extra credit may be allowed at the discretion of the instructor.

Final Grade determined by scale shown below.

Letter Grade	GPA for Course	% of Total Points Earned for Course
A	4.00	90-100
B	3.00	80-89
C	2.00	70-79
D	1.00	60-69
F	0.00	<60

See separate course schedule for lecture plan, reading, and (suggested) homework assignments.

Relation of Course to Department ABET Objectives: 1 & 2
Relation of Course to Department ABET Outcomes: a,b,g,h, and e