

## **ECE435/635: GROUNDING AND SHIELDING, Spring 2010**

9:05 – 9:55 MWF

**INSTRUCTOR:** Prof. T. H. Hubing, Hubing@clemson.edu

**OFFICES:** 310 Fluor Daniel Bldg., 656-7219  
330 GCEC, 283-7218

**OFFICE HOURS:** EIB 10 – 11 am, MWF; CGEC 10 – 11 am, TTH

**OPTIONAL TEXT:** Paul, C. R., Introduction to Electromagnetic Compatibility, 2<sup>nd</sup> ed., Wiley Interscience, ISBN-13: 978-0-471-75500-5, 2006.

**REQUIRED CLASS NOTES:** (Distributed electronically in pdf format via the Blackboard site)

### **COURSE OBJECTIVES**

1. To understand the fundamentals of electromagnetic compatibility, including noise coupling, radiated emissions, radiated susceptibility, electrostatic discharge and lightning.
2. To gain an ability to diagnose and solve noise problems in real circuit boards or electronic systems.
3. To be able to estimate resistance, capacitance and inductance parameters and reduce complex noise issues to basic circuit problems.
4. To be able to recognize the unintentional sources, coupling paths and antennas in a typical electronic system.
5. To be able to apply proper grounding, shielding and filtering techniques when appropriate to improve the electromagnetic compatibility (and/or reduce the cost) of electronic devices.

### **HOMEWORK**

Homework is due approximately once each week. Students can work together on homework, but must turn in their own work. Homework assignments that are essentially copies of another student's assignment will not be accepted. Homework is due at the beginning of class. 10% will be deducted from homework that is turned in up to 24 hours late. 50% will be deducted from homework that is turned in between 1 day and 1 week late.

### **TESTS AND GRADING**

Course Grades will be determined based on the following percentages:

<b><u>ECE435</u></b>	<b><u>ECE635</u></b>
Homework: 25%	Homework: 15%
2 Exams: 30%	2 Exams: 30%
Quizzes: 20%	Quizzes: 10%
Final Exam: 25%	Project: 20%
	Final Exam: 25%

## TOPICS TO BE COVERED

	<u>Reading Assignment</u>
EMC Introduction, History	Introduction, dB_Notes
EMC Regulations, EMC Tests, Significant Figures, dB	
Non-Ideal Behavior of Components, Resistance	Resistance_Notes
Capacitance	Capacitance_Notes
Inductance	Inductance_Notes
Transmission Lines	Transmission_Line_Notes
Common Impedance Coupling	Common_Impedance_Coupling_Notes
Electric Field Coupling	Electric_Field_Coupling_Notes
Magnetic Field Coupling	Faraday's_Law_Notes, Magnetic_Field_Coupling_Notes
Crosstalk in Electrically Long Transmission Lines	Crosstalk_Notes
Frequency-Domain Representation of Time-Domain Signals	Time_Frequency_Notes
Tracing Current Paths	Current_Path_Notes
Radiation from Circuits, CM and DM currents	Radiation_Notes
Cables and Slots as Antennas	
Introduction to Shielding Theory	Shielding_Notes (Part_1)
Practical EMI Shielding	Shielding_Notes (Part_2)
Practical EMI Filtering	
Printed Circuit Boards as EMI Sources	PCB_Layout_Notes
Susceptibility Issues with Printed Circuit Boards	
Power Bus Decoupling	Power_Bus_Decoupling_Notes
PCB Design and Layout	Layout_Guidelines
Circuit and System Ground	
Conducted EMI Sources	Conducted_EMI_Notes
EMI/EMC Design Examples	
Electrostatic Discharge	Electrostatic_Discharge_Notes
Lightning	
Transient Protection	Transient_Protection_Notes
EMI Trouble Shooting	
Course Review	Sample_Final_Exam

## ATTENDANCE POLICY

Students are expected to attend every class and arrive on time. Students who know in advance that they must miss a class should inform the instructor and arrange to take any quizzes scheduled for that day early. Students who miss a quiz because they are late or because they are absent on the day of the quiz will receive a zero for that quiz unless other arrangements were made prior to the start of that class.

In the *highly unlikely* event that the professor is late for class, students are expected to wait 15 minutes for him to show up.

## DISABILITY ACCESS STATEMENT

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students are encouraged to contact Student Disability Services to discuss their individual needs for accommodation.