Department	Electrical and Computer Engineering
Course Number	**EE 409**
Course Title	Material Science
Course Designation	Required
University Catalog Description	Semesters offered: F Prerequisites: EE 316 -- Basic material properties of dielectrics magnetic materials, conductors and semiconductors. Practical applications of materials to semiconductor devices.
Faculty Coordinator	Dr. Todd Kaiser
Prerequisite by Topic	Microelectronic circuits and devices
Textbook	Kasap, Principles of Electronic Materials and Devices, 3rd edition, McGraw Hill, 2006
Course Objectives	This course provides a broad introduction to material properties which are relevant to electrical engineering. Each student will be given an appreciation for the interactions between materials properties, the devices, subsystems and products which result from their use. This class is an attempt to integrate all of these topics and provide an introduction to the design process from a materials viewpoint.
Course Learning Outcomes	At the conclusion of EE 409, students are expected to : 1) Understanding of the physical processes in a material which determine the specifications of a particular electronic device. 2) Be able to break a complex electronic materials problem down into smaller pieces, each of which can be more easily solved, with the interactions between each sub-problem clearly identified and quantified. 3) An understanding of the limits material properties impose upon electronic device specifications. 4) Given a design specification, a student should be able to select a set of candidate materials which can provide a solution for the design problem. From these materials, the student should then be able to find commercially available devices which use these materials. 5) Given a set of specifications claimed for a device, a student should be able to confirm the validity of those specifications based on the properties of the materials used in the device and the device geometry. 6) An understanding of the statistical nature of electron populations in semiconductors and the quantized statistics associated with current flow.
Topics Covered	1) Atomic Bonding and types of bonds 2) Kinetic Molecular Theory 3) Thermally Activated Processes 4) Solid Solutions 5) Phase Diagrams 6) Thermal Conduction in solids 7) Electrical Conduction 8) Band Theory of solids 9) Thermionic Emission and Vacuum Tubes 10) Piezoresistivity 11) Metal Semiconductor contacts 12) Thermoelectric coolers 13) Semiconductor Basics 14) Carrier Generation and Recombination 15) Semiconductor Devices 16) Dielectric Materials 17) Polarization Mechanisms 18) Piezoelectricity 19) Magnetization and Magnetic Properties 20) Magnetic Domains 21) Optical Properties of Materials
Class/Laboratory Schedule	EE 409 meets three times /week for 50 minutes

Professional Component (Criterion 5)	The student will develop skills needed to create a professional quality term paper. The student will acquire an appreciation for the interplay between conflicting specification requirements when designing an electrical apparatus, with an emphasis on materials selections.
ECE Program Outcomes	EE 409 supports following Program Outcomes: a. an ability to apply knowledge of mathematics, science and engineering b. an ability to design and conduct experiments, as well as to analyze and interpret data e. an ability to identify, formulate, and solve engineering problems. g. an ability to communicate effectively. i. a recognition of the need for, and an ability to engage in life-long learning. k. an ability to use the techniques, skills and modern engineering tools necessary for engineering practice l. been exposed to the principles of project management and design trade-offs. r. an ability to analyze and synthesize electronic devices and electrical systems
Total Credit Hours	3
Prepared by	Todd Kaiser 5/2009