



University Bulletin

Undergraduate Degree Programs

Engineering Science (E SC)

E SC 314 Engineering Applications of Materials (3) Basic concepts of material structure and their relation to mechanical, thermal, electrical, magnetic, and optical properties, with engineering applications. (E SC 314 is not intended for students in E SC major)

E SC 314 Engineering Applications of Materials (3)

This course is intended primarily for Electrical Engineering and Materials Science and Engineering majors, as a core-level exposure to the electron-based properties of materials and their engineering applications. Building upon a basic foundation from early Physics courses, it offers an introduction to the behavior of electrons in crystalline as well as non-crystalline solids, and its impact on properties. A comprehensive treatment of electrons in solids is essential to understand the electronic, optical, thermal, magnetic and other properties of materials and their incorporation in functional devices. The topics are chosen to deal with all the basic facets of electrons in solids and their response to external fields and waves, and lead up to a broad range of elementary device applications. It thaws upon the results of quantum mechanics and band theory of solids that provide the broad umbrella needed for understanding the properties of materials and designing them into practical devices including the new class of nanosystems. The development of the energy band diagram is shown to offer a convenient model for understanding the properties of materials and designing device structures. The overwhelming role of semiconductors as building blocks of modern electronics is emphasized by introducing the key concepts of doping, electron transport by drift and diffusion, and electron-photon interactions. The students are shown the strong link connecting atomic bonding, physical structure and material properties in order that they understand the need for and emergence of artificially synthesized structures and new device phenomena. Along with a detailed coverage of semiconductors due to their widespread applications and their dominance in modern micro- and optoelectronics, a basic introduction to dielectric and magnetic properties is also included. Engineering applications involving sensing and transduction as well as signal amplification and energy conversion will be interspersed in the discussions of properties throughout the course. The role of defects, impurities and interfaces on electrical, optical and other properties are introduced briefly, along with corresponding applications in device structures. The devices discussed include p-n junctions, metal-semiconductor contacts, bipolar and field effect transistors, optical detectors and light emitting diodes.

The broad topical coverage will prepare students for advanced studies in a variety of fields including micro- and optoelectronics and functional microsystems. The course provides essential background for senior technical electives on semiconductor devices and processing as well as nanotechnology, and also complements courses that deal with atomic structure and mechanical properties of materials.

General Education: None

Diversity: None

Bachelor of Arts: None

Effective: Spring 2007

Prerequisite: **PHYS**

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Note : Class size, frequency of offering, and evaluation methods will vary by location and instructor. For these details check the specific course syllabus.

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