ESG 281 Engineering Introduction to the Solid State (Required)

Course Catalog description:

A discussion of relativity followed by review of the atom and its constituents. Lectures treat the quantization of light and of atomic energy levels, matter waves, and introduce the Schrodinger equation, first in one dimension, then in three dimensions. Electron spin and magnetic effects are discussed, followed by multi-electron atoms and the periodic table. Radiation and lasers, molecules and solids, including conductors, semiconductors, and insulators. [4 credits]

Pre- or Corequisite(s): PHY 132E Classical Physics II/ PHY 134 Classical Physics Laboratory II or PHY 142E Classical Physics B and PHY 127E Classical Physics C

Text(s): John R. Taylor & Chris D. Zafirators, Modern Physics for Scientists and Engineers, Prentice Hall Inc., 1991, ISBN# 0135897890

Course learning outcomes:

ESG 281 is a broad introductory survey of twentieth century physics. Students are expected to gain fluency in basic concepts of modern and introductory solid-state physics and their engineering applications. Students are also expected to gain an appreciation of the backgrounds and approaches that led to important discoveries. The student is expected to demonstrate an understanding of the science and the practical development of concepts. Advanced mathematics is not required. Students are encouraged to adapt a can-do attitude towards the eclectic nature of physics and its engineering applications.

Topics Covered:

Week 1. Mass-energy, relativistic momentum and energy
Week 2. Atoms, atomic mass, mole, e/m, oil drop, Rutherford.
Week 3. Black body, photoelectric effect, X-rays, Compton
Week 4. Atomic spectra, Bohr, Moseley, Franck-Hertz
Week 5. De Broglie, Wave function, Sinusoidal waves, Wave packets, Heisenberg, Wave packet velocity
Week 6. Waves, Particle in a box, stationary states, Particles in a rigid box, Free particle, nonrigid box, Harmonic oscillator
Week 7. 3D Schrodinger equation, 2D central force, Angular momentum, energy levels, Electron shells
Week 8. Electron spin, magnetic moment, Zeeman effect, spin magnetic moment, Anomalous Zeeman effect
Week 9. IPA Pauli exclusion principle, Elements, Periodic table, excited states
Week 10. Absorption, stimulated emission, Spontaneous emission, Lasers
Week 11. Molecules, Ionic, Covalent bonds, H_2 molecule, Excited States, Molecular spectra
Week 12. Bonding, Crystals, Energy bands, Semiconductors, Phonons, Superconductivity

Class/ Laboratory Schedule:

ESG Fall	281	Engnrng Intro to Solid State	LEC	1	MF	12:50 PM	2:10 PM
			REC	R01	RECM	11:45 AM	12:40 PM
			REC	R02	RECM	10:40 AM	11:35 AM
			REC	R03	RECM	2:20 PM	3:15 PM
ESG	281	Engnrng Intro to Solid State	LEC	1	TUTH	8:20 AM	9:40 AM

Spring							
			REC	R01	RECM	11:45 AM	12:40 PM
			REC	R02	RECM	12:50 PM	1:45 PM

Contribution of Course to meet requirement of Criterion 5:

Students are expected to be aware of the limits of classical dynamics and therefore aware of the need to apply relativistic, molecular level, and/or quantum approaches to appropriate problems. The course prepares students for subsequent specialized class work and prepares them for research and discovery, its challenges and its rewards, through the consideration of those who built twentieth century physics.

Relationship of course to program outcomes:

Outcomes	Percentage of course
Fluency in basic concepts (outcome A)	55%
Mathematical expression of Mod./Solid State Physics relations (Outcome E)	25%
Appreciation of background & approaches (Outcome H)	10%
Practical applications of concepts (Outcome K)	10%

Person(s) who prepared this description and date of preparation:

Charles Fortmann 03/03/09