EC E 466, Electronics of Solids

1. Credits : 3   Contact Hours : 5.5

3. Other Supplemental Materials : None

- **Specific Course Information :**
  
a. Brief description of the content of the course (Course Catalog Description) :

b. Pre-requisites or Co-requisites : ECE 335, 305, or consent of instructor
c. This is a Selected Elective course.

- **Specific Goals for the Course :**

  a. Course Outcomes :

1. The course is intended to provide a broad perspective of the role that nanoelectronics and solid state physics plays for Engineering and to serve as the engineering foundation for subsequent, more advanced courses.
2. Applications starting from electrical (nano-electronics), over to magnetic (spintronics), and nanomechanical engineering perspectives will be discussed in both descriptive and quantitative terms.
3. The overall goals of this course are to instill physical intuition regarding nanoelectronic systems and to allow students to develop an appreciation for how engineering and mathematics can be applied to the analysis and constructive manipulation of these.

- **ABET Student Learning Outcomes:**
  
  (a) Ability to apply mathematics, science and engineering principles.
  (b) Ability to design and conduct experiments, analyze and interpret data.
  (e) Ability to identify, formulate and solve engineering problems.
  (g) Ability to communicate effectively.
  (i) Recognition of the need for and an ability to engage in life-long learning.
  (j) Knowledge of contemporary issues.
  (k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered:**
  
  1. Wave-particle duality, Schrodinger equation, free electrons
  2. Particle-in-a-box
  3. Electrons in periodic potentials
  4. Real and reciprocal lattices, Brillouin zones and Wigner-Seitz cells
  5. Electron energy levels in real materials
  6. Review of electricity and electrical measurements, Drude model
  7. Consequences of the Drude model, electrical properties of metals
  8. Large scale optical properties
  9. Electrons in a magnetic field
  10. Semiconductors: Band structure and doping I
  11. Heterostructures
  12. Density of states, effective mass
  13. Fermi distribution, Fermi surfaces
  14. Electrical properties of metals revisited
  15. Band structures of real metals and metallic glasses
  16. Band structure and doping II
  17. Hall effect, conduction by holes in semiconductors and metal
  18. PN junctions, Schottky diodes
  19. BJTs and FETs
  20. Optical absorption, spectra of metals and semiconductors
  21. Organic "metals" and semiconductor
  22. Magnetism: electron spin, para- and diamagnetism in solid
  23. Superconductors