University of Tehran
School of Electrical and Computer Engineering

Course:	**(8101xxx) -Advanced Solid State Physics**
Course type:	EE*: Com ☐ Required, E ☒ Elective, P ☐, B ☐, Con ☐, D ☐ Required ☐ Elective; CE*: SW ☐ Required ☐ Elective, HW ☐ Required ☐ Elective, IT ☐ Required ☐ Elective; Credit: 3
Level:	Graduate
Co-requisite(s):	-
Prerequisite(s):	-
Prerequisite by topic:	Familiarity with quantum physics and solid state physics.
Textbook(s):	[1] S. Datta, "Quantum Transport: Atom to Transistor", Cambridge University Press (2005). [2] C. Kittel, "Introduction to Solid State Physics", Wiley (2004).
Coordinator:	S. Mohajerzadeh, Professor, School of ECE
Goals:	This is a theoretical course in which students become familiar with complex concepts of energy-momentum diagrams in real semiconductors as silicon and GaAs compounds. Two important approximations as plain-wave and tight-binding techniques are elaborated and assignments are delivered. In the second half of the course, electron scattering and its quantum theory are derived and electron-electron and electron-phonon scatterings are fully discussed. Phonon dispersion diagram of true materials are discussed and assignments are delivered. Students become familiar with various methods for density of state analysis including effective mass and histogram methods. Electron-photon scattering is discussed and it is extended to electron-photon-phonon scattering.
Outcome:	Upon successful completion of the course, students will have: 1. knowledge about many-body systems, 2. knowledge of Schrodinger Equations and electron orbitals 3. knowledge of E-K diagram based on two main approximations, 4. knowledge of phonon modeling and interaction with electrons 5. knowledge about scattering and methods to model it 6. knowledge about dispersion diagrams and how to analyze them

Topics:	**1- A survey of Schrodinger's Equation** 2- **Plain Wave approximation, structure factor** 3- **Tight-binding, s-p-d orbitals, E-K diagrams** 4- **Density functional theory, Siesta** 5- **Density of States, effective mass** 6- **Scattering theory, electron-ion interactions** 7- **Phonons: dispersion diagram** 8- **Electron-phonon scattering,** 9- **Born-Oppenheimer Approximation**
Computer usage:	Siesta Simulation tool, DOS histogram, E-K diagrams, Dispersion diagram
Assignments:	Threes home-works are given to the students to become familiar with topics.
Projects:	Assignments are given
Grading:	Assignments: 20 % Quiz: 0% Midterm exams: 30 % Final exam: 50 %
Further readings:	
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Date:	September 2017

*EE: Electrical Engineering CE: Computer Engineering IT: Information Technology