



## Course Syllabus: Electrical & Optical Prop of Semicond. - EE 306

<b>Division</b>	Computer, Electrical and Mathematical Sciences & Engineering
<b>Course Number</b>	EE 306
<b>Course Title</b>	Electrical & Optical Prop of Semicond.
<b>Academic Semester</b>	Spring
<b>Academic Year</b>	2018/2019
<b>Semester Start Date</b>	01/27/2019
<b>Semester End Date</b>	05/23/2019
<b>Class Schedule</b> (Days & Time)	10:30 AM - 12:00 PM   Tue Thu

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Kazuhiro Ohkawa	kazuhiro.ohkawa@kaust.edu.sa	+966128080701	2226, 3, Ibn Sina (bldg. 3)	Thursday 4-6pm. If you need other time slots, please email me.

Teaching Assistant(s)	
Name	Email

Course Information	
<b>Comprehensive Course Description</b>	This course deals with optical and electrical properties of semiconductors including their characterization methods. Every semiconductor has a unique value of bandgap based on its atomic arrangement as crystal. Impurities in semiconductors are the origin of additional carriers which occupies the major electrical properties. The impurities influence optical property as well. We will study not only n-type and p-type semiconductors but also their heterostructures and quantum structures. The knowledge of these fields is valuable to judge material quality, understand device operation, and design new devices.
<b>Course Description from Program Guide</b>	The course discusses in detail the theory behind important semiconductor based experiments such as Hall effect and Hall mobility measurement, velocity-field measurement, photoluminescence, gain, pump-probe studies, pressure and strain dependent studies. Theory will cover: Band structure in quantum wells; effect of strain on band structure; transport theory; excitons, optical absorption, luminescence and gain.
<b>Goals and Objectives</b>	Students are expected to acquire sufficient knowledge of semiconductors as materials and devices. Students will <ol style="list-style-type: none"> <li>1. review basic of solid state physics</li> <li>2. study crystal structures and bandgaps</li> <li>3. understand origin of carriers and their dynamics</li> <li>4. learn optical transition phenomena in semiconductors including their characterization technologies.</li> </ol>
<b>Required Knowledge</b>	Solid state physics
<b>Reference Texts</b>	C. Kittel, "Introduction to Solid State Physics", Wiley Others will be announced in the class.
<b>Method of evaluation</b>	<b>20.00%</b> - Attendance and Participation <b>20.00%</b> - Final exam <b>45.00%</b> - Quiz(zes) <b>15.00%</b> - Written report

<b>Nature of the assignments</b>	Students must work independently on their report, presentation, homework, and other assignments.
<b>Course Policies</b>	Late homework and assignments will not be evaluated.
<b>Additional Information</b>	

### Tentative Course Schedule

*(Time, topic/emphasis & resources)*

<b>Week</b>	<b>Lectures</b>	<b>Topic</b>
1	Tue 01/29/2019 Thu 01/31/2019	Introduction of semiconductor physics Fermion and Fermi-Dirac distribution function
2	Tue 02/05/2019 Thu 02/07/2019	Density of states (3D, 2D, 1D) Density of states (quantum well, wire, dot)
3	Tue 02/12/2019 Thu 02/14/2019	Heat capacity of the electron gas Wiedemann-Franz law
4	Tue 02/19/2019 Thu 02/21/2019	Quiz 1 Ionic and covalent bonds
5	Tue 02/26/2019 Thu 02/28/2019	Spring Break
6	Tue 03/05/2019 Thu 03/07/2019	Semiconductor structures Origin of bandgap 1
7	Tue 03/12/2019 Thu 03/14/2019	Origin of bandgap 2, 3
8	Tue 03/19/2019 Thu 03/21/2019	Drawing Bandgap Reduced zone scheme
9	Tue 03/26/2019 Thu 03/28/2019	A shape of bandgap 1, 2
10	Tue 04/02/2019 Thu 04/04/2019	Number of states in a band Quiz 2
11	Tue 04/09/2019 Thu 04/11/2019	Electrical property (effective mass) Intrinsic semiconductor
12	Tue 04/16/2019 Thu 04/18/2019	Carrier transport in heterostructures
13	Tue 04/23/2019 Thu 04/25/2019	High electron mobility transistors
14	Tue 04/30/2019 Thu 05/02/2019	Tunnel junction
15	Tue 05/07/2019 Thu 05/09/2019	Photoabsorption phenomena
16	Tue 05/14/2019 Thu 05/16/2019	Photoabsorption devices
17	Tue 05/21/2019 Thu 05/23/2019	Final Exam Week

#### Note

The instructor reserves the right to make changes to this syllabus as necessary.