



Course Syllabus: Electronic Properties of Materials - MSE 225

Division	Physical Science and Engineering Division
Course Number	MSE 225
Course Title	Electronic Properties of Materials
Academic Semester	Fall
Academic Year	2018/2019
Semester Start Date	08/26/2018
Semester End Date	12/11/2018
Class Schedule (Days & Time)	09:00 AM - 10:30 AM Mon , 10:30 AM - 12:00 PM Sun

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Thomas Anthopoulos	THOMAS.ANTHOPOULOS@KAUST.EDU.SA	+966128087283	3235, 5, Al-Kindi (bldg. 5)	

Teaching Assistant(s)	
Name	Email

Course Information	
Comprehensive Course Description	<p>The main objective of the course is to provide an overview of the electronic properties of materials with emphasis on fundamental physical models that describe the crystal structure, chemical bonding, band structure of solids, charge carrier transport in semiconductors and metal-semiconductor junctions. This will be followed by an introduction to the operating principles of important solid-state electronic devices and their applications. After attending the course the students should be able to understand the origin of electrical properties of materials and their relation to the operating principles of key devices used in modern day electronics.</p> <p>Course Topics</p> <ul style="list-style-type: none"> -Crystal Structure -Diffraction -Chemical Bonding -The Atom and Energy Band Formation -Electron and Holes in Solids -Charge Transport in metal-semiconductor and semiconductor-semiconductor junctions -Dielectrics -Semiconductor Devices and Applications -Emerging Electronic Materials
Course Description from Program Guide	<p>The objective of this course is to present the fundamental concepts of structural, electrical and optical properties needed to understand the behavior of the materials. The course includes a brief description of crystal structure of solids, and the basics of x-ray diffraction theory; free electron theory in metal and band theory will be addressed. A brief review of thermal and lattice vibration properties will be presented. A brief introduction on key electronic devices based on homo p-n junctions and hetero-junctions. A Brief description of dielectric materials.</p>

Goals and Objectives	The main objective of the course is to provide an overview of the electronic properties of materials with emphasis on fundamental physical models that describe the crystal structure, chemical bonding, band structure of solids, charge carrier transport in semiconductors and metal-semiconductor junctions. This will be followed by an introduction to the operating principles of important solid-state electronic devices and their applications. After attending the course the students should be able to understand the origin of electrical properties of materials and their relation to the operating principles of key devices used in modern day electronics.
Required Knowledge	Although there is no official pre-requisite, some background on solid state physics and/or electronic materials will be useful.
Reference Texts	<p>Suggested reading</p> <ol style="list-style-type: none"> 1. Lecture notes 2. Problem/tutorial sheets <p>Books</p> <ol style="list-style-type: none"> 3. Electronic Properties of Materials Rolf E. Hummel 4. Solid State Physics: Ashcroft / Mermin 5. Principles of Semiconductor Devices: Neamen
Method of evaluation	<p>30.00% - Presentation 35.00% - Exam 2 35.00% - Exam 1</p>
Nature of the assignments	Each student will be required to choose a relevant scientific topic from the literature (e.g. a SCI journal article) and present it to the rest of the class in the form of an oral presentation that will be followed by a question & answer session.
Course Policies	<ul style="list-style-type: none"> - Exams and oral presentations are required - Absences: Students are expected to notify the instructor about potential absence(s) well in advance.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/26/2018	Introduction to the course
1	Mon 08/27/2018	Crystal structure
2	Sun 09/02/2018	Diffraction
2	Mon 09/03/2018	Chemical bonding
3	Sun 09/09/2018	Atom & Band Formation
3	Mon 09/10/2018	Atom & Band Formation
4	Sun 09/16/2018	Energy band formation
4	Mon 09/17/2018	Energy band formation & Distribution of Problem Sheet 1
5	Sun 09/23/2018	No lecture (National Day Holiday)
5	Mon 09/24/2018	Holes and electrons in solids
6	Sun 09/30/2018	Holes and electrons in solids
6	Mon 10/01/2018	Discussion of Problem Sheet 1
7	Sun 10/07/2018	Semiconductor junctions & Distribution of Problem Sheet 2
7	Mon 10/08/2018	Semiconductor junctions
8	Sun 10/14/2018	Discussion of Problem Sheet 2
8	Mon 10/15/2018	Review for Mid-Term Exam (No lecture)
9	Sun 10/21/2018	Mid-Term Exam
9	Mon 10/22/2018	Metal-semiconductor junction
10	Sun 10/28/2018	Metal-semiconductor junction & Distribution of Problem Sheet 3
10	Mon 10/29/2018	Discussions on Problem Sheet 3
11	Sun 11/04/2018	The MOS capacitor
11	Mon 11/05/2018	Presentations (self-study: No lecture)
12	Sun 11/11/2018	Presentations
12	Mon 11/12/2018	Presentations
13	Sun 11/18/2018	Semiconductor devices
13	Mon 11/19/2018	Semiconductor devices & Distribution of Problem Sheets 4
14	Sun 11/25/2018	Discussion of Problem Sheet 4
14	Mon 11/26/2018	Principles of IC manufacturing
15	Sun 12/02/2018	Emerging Semiconductor Material Technologies
15	Mon 12/03/2018	Revision Lecture 1
16	Sun 12/09/2018	Revision Lecture 2
16	Mon 12/10/2018	Final Exam

Note

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