جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

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	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
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	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. **Course Topics** -Crystal Structure -X-ray 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	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 crustal 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.

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	**Suggested reading** 1. Lecture notes & handouts 2. Problem / tutorial sheets **Books** 3. Electronic Properties of Materials Rolf E. Hummel 4. Solid State Physics: Ashcroft / Mermin 5. Principles of Semiconductor Devices: Neamen
Method of evaluation	**30.00**% - Oral presentation **35.00**% - Midterm exam **35.00**% - Final exam
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. The criteria that will form the basis for evaluating the oral presentation(s) will be discussed wiht the class in advance.
Course Policies	- Exams and oral presentations are required - Absences: Students are expected to notify the instructor about potential absence(s) in advance.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 08/25/2019	Introduction to the course
1	Mon 08/26/2019	Crystal structure
2	Sun 09/01/2019	Diffraction
2	Mon 09/02/2019	Chemical bonding
3	Sun 09/08/2019	Atom & Band Formation
3	Mon 09/09/2019	Atom & Band Formation
4	Sun 09/15/2019	Energy band formation
4	Mon 09/16/2019	Energy band formation (Problem sheet 1)
5	Sun 09/22/2019	University holiday (No lecture)
5	Mon 09/23/2019	Saudi National Day (No lecture)
6	Sun 09/29/2019	Holes and electrons in solids
6	Mon 09/30/2019	Holes and electrons in solids
7	Sun 10/06/2019	Review for Mid-Term Exam (No lecture)
7	Mon 10/07/2019	**Mid-Term Exam (1.5 hours)**
8	Sun 10/13/2019	Semiconductor junctions (Problem sheet 2)
8	Mon 10/14/2019	Metal-semiconductor junction
9	Sun 10/20/2019	Metal-semiconductor junction
9	Mon 10/21/2019	The MOS capacitor (Problem sheet 3)
10	Sun 10/27/2019	Mid-semester break (No lecture)
10	Mon 10/28/2019	Mid-semester break (No lecture)
11	Sun 11/03/2019	**Oral Presentations (Group 1)**
11	Mon 11/04/2019	**Oral Presentations (Group 2)**
12	Sun 11/10/2019	Semiconductor devices
12	Mon 11/11/2019	Semiconductor devices
13	Sun 11/17/2019	Semiconductor devices (Problem sheets 4)
13	Mon 11/18/2019	Principles of IC manufacturing
14	Sun 11/24/2019	Emerging electronic materials
14	Mon 11/25/2019	Emerging electronic materials
15	Sun 12/01/2019	Revision for final exam
15	Mon 12/02/2019	Revision for final exam
16	Sun 12/08/2019	**Final Exam (2 hours)**
16	Mon 12/09/2019	---- No lecture ----

Note

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