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

Course Syllabus: Semiconductor Materials - MSE 322

Division	Physical Science and Engineering Division
Course Number	MSE 322
Course Title	Semiconductor Materials
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	01:00 PM - 02:30 PM | Wed Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Iman Salem Roqan	iman.roqan@kaust.edu.sa	+966128084340	R-3221 (sea-side), 3, Ibn Sina (bldg. 3)	Sunday 1-3 Tuesday 3-5

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	This course is advanced semiconductor course that focus on understanding the physical, optical and structural properties of semiconductor materials including semiconductor alloys, amorphous semiconductors, and nanostructure semiconductors. The applications of these semiconductors will be briefly described. In addition, the physics of several growth and characterization techniques will be taught for the students. The class will involve practical lab work. In the end of this course the student should have a good understanding on the semiconductor properties and most important growth and characterization techniques.
Course Description from Program Guide	The course covers the physico-chemical and electronic properties of advanced semiconductor materials other than Si and GaAs. The materials that will be covered include elemental semiconductors such as Ge and carbon (in the form of carbon nanotubes and graphene), compound semiconductors such as III-V and II-VI compounds, and wide-band gap semiconductors such as carbides and nitrides. Special classes of semiconductors such as oxides, chalcogenides, and polymeric semiconductors will be included. In each material category, the material processing and fabrication of select devices will be discussed including 1-dimensional and 2-dimensional devices. Measurement protocols for the devices will be presented.
Goals and Objectives	At the end of this course students will be able -Understand the Engineering of the electronic band structure and crystal structure of semiconductor materials. -Interpret the semiconductor alloys and bandgap bowing. -Understand amorphous semiconductor band structure and electrical behavior. -Explain optical properties of semiconductor . -Be familiar with the optical and structural characterization techniques and the related lab work
Required Knowledge	Students should be familiar with the contents of, Electronic properties of materials or equivalent Quantum mechanics Thermodynamics

Reference Texts	The textbooks -The Materials Science of Semiconductors by Angus Rockett -The Physics of Semiconductors: An Introduction Including Nanophysics and Applications by Marius Grundmann -Optical properties of Solid by Mark Fox -Semiconductor material and device characterization by Dieter K. Schroder Addition reference books -Electronics structures and the properties of Solids: physics of chemical bonds by Harrison. -Electrical properties of materials by Solymar -Advance semiconductor fundamentals by Pierret -Introduction to solid state physics by Kittel
Method of evaluation	**40.00**% - Final exam **10.00**% - Oral presentation **30.00**% - Midterm exam **15.00**% - Homework /Assignments **5.00**% - Attendance
Nature of the assignments	-Exams -literature review -presentations -Homeworks
Course Policies	Students should attend all sessions (frequent absence will be penalized in up to 5% of final grade). Additional class may took place for tutorials after each chapter
Additional Information	As it is an advance topic, students who did not have the background knowledge on quantum mechanics and thermodynamics will be not able to follow the classes without these knowledge that may affect their performance in the class

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Wed 08/28/2019	Band Theory (Solution of the Schrodinger Equation)
1	Thu 08/29/2019	Band Theory (Solution of the Schrodinger Equation)
2	Wed 09/04/2019	Engineering of the band structure of different types of semiconductors
2	Thu 09/05/2019	Engineering of the band structure of different types of semiconductors
3	Wed 09/11/2019	Engineering of the band structure of different types of semiconductors
3	Thu 09/12/2019	Tutorials
4	Wed 09/18/2019	Engineering of Semiconductor alloys including metastable materials and applications
4	Thu 09/19/2019	Engineering of Semiconductor alloys including metastable materials and applications
5	Wed 09/25/2019	Tutorials
5	Thu 09/26/2019	Band structure of amorphous semiconductor
6	Wed 10/02/2019	The electronic properties of amorphous semiconductor
6	Thu 10/03/2019	The optical and electrical properties of amorphous semiconductor
7	Wed 10/09/2019	Tutorials
7	Thu 10/10/2019	Crystal Growth and Epitaxy
8	Wed 10/16/2019	Tutorials +Revision
8	Thu 10/17/2019	Mid term exam
9	Wed 10/23/2019	Electrical properties of semiconductors
9	Thu 10/24/2019	Optical properties of Semiconductor and excitonic behavior
10	Wed 10/30/2019	The physics of defects and related properties in Semiconductors
10	Thu 10/31/2019	The physics of nanostructures
11	Wed 11/06/2019	The electric and optical properties of nanostructure
11	Thu 11/07/2019	Tutorial
12	Wed 11/13/2019	understanding the physics of characterisation techniques
12	Thu 11/14/2019	understanding the physics of characterisation techniques
13	Wed 11/20/2019	Tutorials
13	Thu 11/21/2019	Additional tutorials for the full class topics
14	Wed 11/27/2019	Presentations of students
14	Thu 11/28/2019	Revision
15	Wed 12/04/2019	Revision
15	Thu 12/05/2019	Final exam

Note

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