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

Course Syllabus: Applied Quantum Mechanics - MSE 304

Division	Physical Science and Engineering Division
Course Number	MSE 304
Course Title	Applied Quantum Mechanics
Academic Semester	Spring
Academic Year	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	04:00 PM - 05:30 PM | Wed Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Enzo Mario Di Fabrizio	Enzo.DiFabrizio@KAUST.EDU.SA	+966128084307	4220 Sea siade, 2, Ibn Al-Haytham (bldg. 2)	Upon email appointment 9:00-12:00 and 15:00-17:00 from Sunday to Tuesday

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	Introduction to non-relativistic quantum mechanics. Summary of classical mechanics and electrodynamics. Postulates of quantum mechanics, wave functions, operator formalism and Dirac notation. Stationary state problems, including quantum wells and tunneling. Harmonic oscillator. Hydrogen atom Time evolution. Approximation methods for time-independent as well as time-dependent interactions.
Course Description from Program Guide	Introduction to non-relativistic quantum mechanics. Summary of classical mechanics and electrodynamics. Postulates of quantum mechanics, wave functions, operator formalism and Dirac notation. Stationary state problems, including quantum wells and tunneling. Harmonic oscillator. Time evolution. Approximation methods for time-independent as well as time-dependent interactions.
Goals and Objectives	-Objective 1: The student will be able to **formulate and explain** fundamental concepts of quantum mechanics -Objective 2: The student will learn to **Solve** Schrodinger equation to **obtain** eigenvectors and energies -Objective 3: The student will learn to **calculate** and **describe** the propagation of a particle in a simple, 1 dimensional potential -Objective 4: The student will learn to **calculate** a Transition Rate by **applying** perturbation theory
Required Knowledge	The student should know about Fourier Transform, Taylor series expansion, basic matrix manipulation, 1st and 2nd order differential equations, as well as standard classical mechanics and electrostatics.
Reference Texts	A.F.J. Levi, *Applied Quantum Mechanics*, Second Edition, Cambridge University Press, ISBN-13 978-0-521-86096-3 ISBN-10 0-521-86096-2 Hans Luth, *Quantum Physics in the Nanoworld* ISBN 978-3-642-31237-3

Method of evaluation	**50.00**% - Final exam **40.00**% - Midterm exam **10.00**% - Homework /Assignments
Nature of the assignments	There will be four homework amounting for 10% of the total grade each. Each homework consists of sets of problems. Students are usually given two weeks to solve these problems and hand over a written report.
Course Policies	The students are expected to attend all classes and to hand over the homeworks on time. No deadline extension will be granted.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Wed 01/31/2018	Hystorical situation in physics before the birth of quantum mechanics
1	Thu 02/01/2018	Hystorical situation in physics before the birth of quantum mechanics
2	Wed 02/07/2018	Quantum mechanics as a framework
2	Thu 02/08/2018	the superposition principle
3	Wed 02/14/2018	The photoelectric effect
3	Thu 02/15/2018	Compton scattering and De Broglie viewpoint
4	Wed 02/21/2018	Matter waves
4	Thu 02/22/2018	the wave of a free particle and the wave packet
5	Wed 02/28/2018	Operators in quantum mechanics
5	Thu 03/01/2018	Schroedinger Equation
6	Wed 03/07/2018	Commutators of different operators
6	Thu 03/08/2018	Interpretation of wave function
7	Wed 03/14/2018	Indetermination principle
7	Thu 03/15/2018	Eigenvalues and eigenfunction. Time evolution of wave function
8	Wed 03/21/2018	Stationary states
8	Thu 03/22/2018	Expectation values on stationary states.
9	Wed 03/28/2018	Infinite square well energy eigenstates.
9	Thu 03/29/2018	Nodes and symmetries of the infinite square well eigen states
10	Wed 04/04/2018	Finite square well energy eigenstates.
10	Thu 04/05/2018	insights on Local de Broglie wavelength.
11	Wed 04/11/2018	Correspondence principle
11	Thu 04/12/2018	Delta function potential and SE solution wave function
12	Wed 04/18/2018	Harmonic Oscillator
12	Thu 04/19/2018	Harmonic oscillator
13	Wed 04/25/2018	Scattering states and the step potential
13	Thu 04/26/2018	Transmission and reflection coefficients in a scattering problem
14	Wed 05/02/2018	Resonant transmission
14	Thu 05/03/2018	Phase shift for a potential well.
15	Wed 05/09/2018	Angular momentum operators and their algebra
15	Thu 05/10/2018	Simultaneous eigenstates and quantization of angular momentum
16	Wed 05/16/2018	Hydrogen atom two-body problem
16	Thu 05/17/2018	Schrödinger equation for hydrogen atom
17	Wed 05/23/2018	Entanglement concepts
17	Thu 05/24/2018	Bell's inequality

Note

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