# *Course Syllabus*

**Course Information**

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|---|---|
| *Course Number/Section* | MSEN 6319 (MSEN6319.001.16F) |
| *Course Title* | Quantum Mechanics for Materials Scientists |
| *Term* | Fall 2017 |
| *Days & Times* | Fridays 13:00 – 15:45 |
| *Location* | SCL-1.202 |

**Professor Contact Information**

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| *Professors* | Robert Wallace |
| *Office Phones* | 972 883 6638 |
| *Email Addresses* | rmwallace@utdallas.edu |
| *Office Location* | NSERL |
| *Office Hours* | **By Appointment** |
| *Other Information* | |

**Course Pre-requisites, Co-requisites, and/or Other Restrictions**

***Students are expected to have mastered the following topics at the undergraduate level prior to this course:***

Math: Geometrical Vectors, Exponential/Trigonometric Notation and Identities, Complex number notation and manipulation, Differential Calculus and Equations, Partial Differential Equations, Vector Calculus, Laplacian and Gradient operators, Summation/Product/Factorial Notation, Integral Calculus, Matrix Algebra and Determinants

Physics: Elementary Classical Mechanics, Electrostatics and Electromagnetism (Maxwell's Equations), Waves (Free space/Plane waves) and Diffraction, Polarization, Energy Density and Flow

Chemistry: Molecular Orbital Theory

**Course Description**

Quantum-mechanical foundation for study of nanometer-scale materials. Principles of quantum physics, operators and Dirac notation, stationary-states for one-dimensional potentials, symmetry considerations. Introduction to: perturbation theory, interaction with the electromagnetic radiation, angular momentum and spin, chemical bonding and molecular orbital theory, crystalline solids and band theory.

**Student Learning Objectives/Outcomes**

You will be expected to achieve the following:

- Understand and explain the application of Quantum Mechanics to describe the nature atoms, molecules and solids.
- Understand and apply methods to obtain approximate solutions of problems of interest to materials science
- Understand and apply the mathematical formulation of Quantum Mechanics
- Understand and explain the nature and physical principles of Quantum Mechanics

You will be expected to demonstrate these objectives by problem solving in homework and exams.

**Required Textbooks and Materials**
*Required Texts*
"Quantum Mechanics for Scientists and Engineers" by David A. B. Miller
ISBN: 978-0-521-89783-9
Cambridge University Press

**Suggested Course Materials**
*Suggested Readings/Texts*

Clifford E. Swartz, "*Used Math*," ISBN-13: 978-0139397448 (Prentice-Hall (1972))

Feynman, Leighton and Sands, "*The Feynman Lectures on Physics*," Vol. 3 (Addison Wesley, New York,1970), ISBN 0201021153/978-0201021158. The pdf of these lectures is now available on-line from CalTech, http://www.feynmanlectures.caltech.edu/.

John Gribbin, "*In Search of Schrödinger's Cat: Quantum Physics and Reality*," ISBN: 978-0553342536 (Bantam Books (1984)).

**Assignments & Academic Calendar**
***(Note: This is a tentative schedule and may be changed at the discretion of the faculty.)***
*Topics, Reading Assignments, Timeline, and Important Dates*

| **Week** | **Date** | **Lecture # - Topic – Readings** *(Homework will be regularly assigned.)* |
|---|---|---|
| **2016** | **2016** | |
| 34 | 8/26 | 1 - Course Overview/Background Review – Ch. 1 + App. A,B,C,D |
| 35 | 9/2 | 2 –Time Independent Schrodinger Equation, Particle in a Box/ 1D Barriers – Ch. 2.1-2.9 |
| 36 | 9/9 | 3 — Harmonic Oscillator/Applied Electric Field – Ch. 2.10-2.12; Time Dependent Schrodinger Equation/Operators – Ch. 3.1-3.5 |
| 37 | 9/16 | 4 – Time Dependent Schrodinger Equation/Operators – Ch. 3.6-3.16 |
| **38** | **9/23** | **5 – Exam 1** |
| 39 | 9/30 | 6 – Functions, Dirac Notation, and More Operators – Ch. 4.1-4.14 |
| 40 | 10/7 | 7 – Operators and Quantum Mechanics – Ch. 5.1-5.5 |
| 41 | 10/14 | 8 – Time Independent Perturbation Theory – Ch. 6.1-6.3,6.7 |
| 42 | 10/21 | 9 – Time Dependent Perturbation Theory – Ch. 7.1, 7.2, 7.5 |
| 43 | 10/28 | 10 – Quantum Mechanics in Crystalline Materials – Ch. 8.1-8.8, 8.11 |
| 44 | **11/4** | **11 – Exam 2** |
| 45 | 11/11 | 12 – Angular Momentum – Ch. 9.1-9.6 |
| 46 | 11/18 | 13 – Hydrogen Atom – Ch. 10.1-10.6 |
| 47 | 11/25 | **University Holiday** |
| 48 | 12/2 | 14 – Spin – Ch. 12.1-8 |
| 49 | TBD | **15 - Final Exam (TBD – SLC 1.202)** |

**Grading Policy**
Grades will be based on the following weights:

Homework 25 %; Term Exams (2) 25 %; Final Exam 25 %

**Homework Assignments**
These are **due no later than THE START OF CLASS on the due date**. No exceptions.
Assignments will be posted on the e-learning site for this course.
Homework must be presented in a professional, legible manner to be graded.
Collaboration (NOT copying) is encouraged. See Academic Integrity Statement in http://provost.utdallas.edu/syllabus-policies/.

**Examinations**
Examinations will be held in class or at an assigned time and will be written.

**Course Policies**
*Make-up exams*
**No make up exams will be given except under extreme circumstances.**
*Extra Credit*
**Not offered.**
*Late Work*
**Not Accepted.**
*Special Assignments*
**None.**
*Class Attendance*
**Not required but is highly advised. Clear your calendar for all class dates, including FINALS week.**
*Classroom Citizenship*
**The Student Conduct and Discipline policy of the University of Texas at Dallas will be followed. See: http://provost.utdallas.edu/syllabus-policies/**

**Field Trip Policies / Off-Campus Instruction and Course Activities**
*None*

**Comet Creed**

*This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:*

"As a Comet, I pledge honesty, integrity, and service in all that I do."

**UT Dallas Syllabus Policies and Procedures**

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.

***These descriptions and timelines are subject to change at the discretion of the Professor. The Instructor may change material, course content, and course pace or item sequence at any time.***