COURSE AND INSTRUCTOR INFORMATION

Course: PHY 420 (Atomic Physics & Quantum Mechanics)
Lecture Location: Schmucker Science North 190
Lecture Time: MWF: 8:00 am – 8:50 am

Instructor: Anil K. Kandalam (Dr. Kandalam or Dr. K)
Office Location: Schmucker Science South, SS 403A
Email: akandalam@wcupa.edu
Office Hours: Monday, Wednesday: 1:30 pm – 3:30 pm
Thursday: 12:00 noon – 1:00 pm
Friday: 9:00 am – 10:00 am or by appointment

COURSE OBJECTIVE

This course is an introductory quantum mechanics course. The goal is for you to acquire a firm grasp of the following fundamental topics: the Schrodinger equation, Solutions to systems with stationary states (potential step, potential well, potential barrier, and harmonic oscillator), an abstract view of quantum mechanics (Dirac notation, Operator methods), the hydrogen atom, Angular momentum, Spin, and if time permits, perturbation theory.

REQUIRED COURSE MATERIALS

Textbook: *Quantum Physics*, Stephen Gasiorowicz (**3rd Edition**)

Reference books for additional reading:
Introduction to Quantum Mechanics, David J. Griffiths (Pearson)
Introductory Quantum Mechanics, Richard Liboff (Addison-Wesley)
Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Eisberg & Resnick (Wiley & Sons)
Quantum Mechanics, Eugen Merzbacher (Wiley)
Quantum Mechanics for Scientists and Engineers, David A. Miller (Cambridge)

EXPECTATIONS

This is a challenging course. Not only are the concepts challenging, but there is a lot of math. You will be using topics from calculus, linear algebra, differential equations, and concepts from mathematical physics. Given the complexity of this course as well as the required mathematical background, you will have to put in a substantial amount of effort. You cannot rely on your time in class and the associated lectures alone to master the topics presented. You will have to spend a great deal of time outside class reading the material covered in the text, studying the examples provided, and working on the problem sets. If you have not done this up to now in your other classes please be forewarned. Don't hesitate to ask me or other professors for help in the material that you have trouble understanding. **DO NOT fall behind in this class!**
Prerequisites: PHY 240, PHY 300, and MAT 343 (or PHY 370). Linear Algebra, although is not technically a prerequisite, might as well be one. If you have not taken all of these courses, it is not a disaster, but you should be ready to learn new math concepts along with new concepts in physics.

COURSE COMPONENTS

Pre-class Reading: You must read before coming to the class. Since, we have limited lecture time, we must focus on the more challenging concepts in the course. Thus, it is critical that you come to lecture knowing the basic elements which we will build on in lecture that day. You need to think deeply about the content and might need to read certain section multiple times.

Lecture: I attempt to make the lecture as informal as possible. I encourage questions during the class.

Problem Sets: There will be one problem set each week (except during the exam weeks). Working the problem sets is very important for mastering this subject. Generally, they will be given out on Mondays and due the following week's Wednesday in class.

EVALUATION

The final grade for this course will be based on the following:

- Problem Sets ……20%
- Exams (3 @ 20% each)……60%
- Final exam…..……..20%

Letter grades will be assigned on the following scale. However, I reserve the right to adjust the weights of individual components, or the scale to account for unforeseen circumstances.

93 – 100 %	A	73 – 76 %	C
90 – 92 %	A–	70 – 72 %	C–
87 – 89 %	B+	67 – 69 %	D+
83 – 86 %	B	63 – 66 %	D
80 – 82 %	B–	60 – 62%	D–
77 – 79 %	C+	59% or lower	F

GRADING COMPONENTS AND POLICIES

Problem Sets: You are encouraged to work together/collaborate on problem sets, but the work that you hand in must be your own and must reflect your own understanding of the material. The best balance between working alone and working with other people is to (i) first work on the problem sets alone. If you are stuck on a problem, then (ii) work with other students and then (iii) complete the problem alone where you can collect your thoughts in peace. Make sure that you understand the solution to each problem that you turn in. If step (ii) does not help, you can always get hints from me during my office hours. Please do not ask from help/hints via. e-mail. Please indicate the names of people you have collaborated with for a problem set.

Regular Exams: There are a total of **three exams** that will be given in the semester. Two of these exams are in-class, while one exam is a take-home exam. **No grades will be dropped** and there are no-make up exams. The exceptions, however, are limited to the absences related to University Sanctioned Events (see below). If you miss an exam for a University Sanctioned Event you must notify me in advance so that we can arrange for you to take the exam in a manner consistent with its integrity. You must also provide some form of documentation (performing arts program, competition schedule etc.

Final Exam: The final exam is a cumulative exam and is MANDATORY. The date and time of the final exam for this course (as set by the registrar, as of 01/19/2015) is:

Friday, May 8, 2015 from 8:00 am – 10:00 am

You should plan to be available for the entire finals week. We have in past semesters had to reschedule finals due to weather related events.

ATTENDANCE POLICY

A regular attendance to the lectures is an important part of this course and I highly recommend it. This is your chance to ask questions, see examples and get help in solving problems. I am here to guide you through the material. Attendance will benefit your understanding and therefore grade. However, I do not give an attendance grade. Students must understand that they are responsible for all material covered and assigned during their absences (excused and unexcused) and that they are responsible for the academic consequences of their absences.

CONTACT POLICY

Please include ***PHY420*** in the subject line of any e-mail. I try to respond to e-mail within 24hrs. Although I will try to answer all questions directed to me by e-mail, most problems related to course content are best discussed during office hours.

ELECTRONIC DEVICES POLICY

In order to create a conductive learning environment, please arrange for all electronic devices to be set in silent/vibrate mode and put away. If you need to use a device to accommodate a disability, please see below.

DISABILITY STATEMENT

If you have a disability that requires special accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodation and meet with me as soon as possible so that I can support your success in an informed manner. Also, contact the Office of Services for Students with Disabilities (OSSD) at (610) 436-2564, their email address is ossd@wcupa.edu, and their website is www.wcupa.edu/ussss/ossd. Sufficient notice is needed in order to make the accommodations possible. Both the WCU and I desire to comply with the ADA of 1990.

ACADEMIC INTEGRITY & CONDUCT

I have a zero tolerance policy for breaches of academic integrity. Breaches of academic integrity will be investigated and sanctions imposed to the full extent available under University policy. For questions regarding the university Academic Dishonesty, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to their major department's handbook, the Undergraduate Course Catalogue, the Rams Eye View, or the University Web Site. Please understand that improper conduct in any of these areas will not be tolerated and may result in immediate ejection from the class.

UNIVERSITY SANCTIONED EVENTS

If you are participating in a University sanctioned event during one of our scheduled exams you must notify me in advance. You must provide some form of documentation. We can then arrange for you to take the exam in a manner consistent with exam integrity. For details please see the discussion of
University Sanctioned Events in the WCU undergraduate catalog.

E-MAIL POLICY STATEMENT

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.

INTELLECTUAL PROPERTY STATEMENT

The instructor utilizes copyrighted materials under the "Freedom and Innovation Revitalizing United States Entrepreneurship Act of 2007" (Fair Use Act). Apart from such copyright protected materials, all other intellectual property associated with this course is owned and copyrighted by the instructor, including, but not limited to, lectures, course discussions, course notes and supplementary materials posted or provided or provided to students authored by the instructor, assessment instruments such as exams, and presentation slides. No recording, copying, storage in a retrieval system, or dissemination in any form by any means of the intellectual property of the instructor, in whole or in part, is permitted without prior written permission of the instructor. When such permission is granted, it must specify the utilization of the intellectual property and all such permissions and waivers shall terminate on the last day of the finals in the semester in which this course is held.

Links and references to on-line resources provided by the instructor may lead to other sites. The instructor does not sponsor, endorse or otherwise approve of any information appearing in those sites, nor is responsible in any way for the content of those sites. The instructor makes no warranty or responsibility for the copyright status of such material. However, should problems with copyright status be brought to the attention of the instructor, reference to offending materials will be removed.

ALL OTHER ACADEMIC POLICIES

For any university wide academic policy not explicitly covered in this document, such NO Grade policies, please consult your major advising handbook, the Undergraduate Catalog, the Ram's Eye View, or University Website.

PUBLIC SAFETY

The Emergency Communications Committee recommends that the number of WCU's Department of public safety be available on every course syllabi. WCU Department of Public Safety: (610) 436-3311.

TENTATIVE SCHEDULE (This schedule is subject to revision.)

	Date		Topic
1	W	Jan. 21	Ch. 1: Emergence of Quantum Physics
2	F	Jan. 23	Ch. 2: Plane Waves & Wave packets
3	M	Jan. 26	Ch. 2 : Probability interpretation of Wave function
4	W	Jan. 28	Ch. 2: Postulates of QM and Schrodinger's Equation (S.E.)
5	F	Jan. 30	Ch. 2: Uncertainty Principle
6	M	Feb. 2	Ch. 2: Expectation Values
7	W	Feb. 4	Ch. 3: Time-Independent S.E.; Eigen Value equations
8	F	Feb. 6	Ch. 3: Infinite Square Well Potential (particle in a box)
9	M	Feb. 9	Ch. 3: Infinite Square Well Potential
10	W	Feb. 11	Ch. 3: Physical Interpretation of Coefficients for a particle in a box
11	F	Feb. 13	Ch. 3: Momentum Eigen Function & Free particle
12	M	Feb. 16	Ch. 4: Potential Step
13	W	Feb. 18	**TEST 1: Chapters 1 – 3**
14	F	Feb. 20	Ch. 4: Free particle & Finite Potential Well
15	M	Feb. 23	Ch. 4: Finite Potential Well
16	W	Feb. 25	Ch. 4: Potential Barrier & Tunneling
17	F	Feb. 27	Ch. 4: Tunneling & Harmonic Oscillator
18	M	Mar. 2	Ch. 4: Harmonic Oscillator
19	W	Mar. 4	Ch. 5 & 6: Introduction to Vector (Hilbert) Space and Operators
20	F	Mar. 6	Ch. 5 &6: Dirac Notation, Hermitian, Adjoint, and Projection Operators
	M	Mar. 9	**SPRING BREAK**
	W	Mar. 11	
	F	Mar. 13	
21	M	Mar. 16	Ch. 5 & 6: Eigen Values and Eigen Vectors of an Operator
22	W	Mar. 18	Ch. 5 & 6: Harmonic Oscillator
23	F	Mar. 20	Ch. 5 & 6: From Operators back to S.E.
24	M	Mar. 23	Ch. 7: Orbital Angular Momentum
25	W	Mar. 25	Ch. 7: Raising and Lowering Operators
26	F	Mar. 27	Ch. 7: Raising and Lowering Operators **[TEST 2 (Take Home Exam): Chapters 4 – 6]**
27	M	Mar. 30	Ch. 7: Eigen functions of Orbital Angular momentum
28	W	Apr. 1	Ch. 7: Eigen functions of Orbital Angular momentum
29	F	Apr. 3	Ch. 8: 3-D problems in Cartesian Coordinates
30	M	Apr. 6	Ch. 8: 3-D problems in Spherical Coordinates: Central Potential
31	W	Apr. 8	Ch. 8: Free Particle in Spherical Coordinates
32	F	Apr. 10	Ch. 8: Spherical Square Well Potential
33	M	Apr. 13	Ch. 8: Hydrogen Atom
34	W	Apr. 15	Ch. 8: Hydrogen Atom
35	F	Apr. 17	Ch. 8: Hydrogen Atom
36	M	Apr. 20	Ch. 10: Spin & Spin Angular Momentum
37	W	Apr. 22	Ch. 10: Pauli Matrices
38	F	Apr. 24	**TEST 3: Chapters 7 – 8**
39	M	Apr. 27	Ch. 10: Addition of Angular Momenta
40	W	Apr. 29	Ch. 10: Clebsch-Gordon Coefficients
41	F	May 1	Ch. 11: Time-Independent Perturbation Theory
42	M	May 4	Ch. 11: Time-Independent Perturbation Theory