COURSE AND INSTRUCTOR INFORMATION

Course: PHY 420 (Atomic Physics & Quantum Mechanics)
Lecture Location: Recitation Hall 301
Lecture Time: MWF: 9:00 am – 9:50 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: 1:00 pm – 3:00 pm
Thursday: 10:00 am – 12:00 noon 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: *Introduction to Quantum Mechanics*, David J. Griffiths, 2nd Edition (Pearson)

Reference books for additional reading:
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)

Note: In some lectures, I will cover certain topics in class that are not discussed in Griffiths. They will be taken from the "Reference books" listed above.

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 (almost) each week. 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 Monday 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 01/12/2016) is:

Wednesday, May 4, 2016 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. If I see anyone **texting or using their cell phones** during the class, **I will take 5 points off of the nearest exam grade**, and you will be considered "absent" for that day, since you are obviously not mentally present.

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.

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.

TITLE IX STATEMENT

West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator, Ms. Lynn Klingensmith. The only exceptions to the faculty member's reporting obligation are when a student communicates incidents of sexual violence during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University protection of minors policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at the webpage for the Office of Social Equity at http://www.wcupa.edu/_admin/social.equity/.

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. 20	Ch. 1: Introduction to Quantum Physics, Wave function, Probabilistic Interpretation
2	F	Jan. 22	Wave Packets (*not from Griffiths*)
3	M	Jan. 25	Postulates of QM and Schrodinger's Equation (S.E.) (*not from Griffiths*)
4	W	Jan. 27	Ch. 2: Stationary States
5	F	Jan. 29	Ch. 2: Infinite Square Well
6	M	Feb. 1	Ch. 2: Infinite Square Well & Symmetric Potential Well
7	W	Feb. 3	Bound States and Unbound States (*not from Griffiths*)
8	F	Feb. 5	Ch. 2: Free Particle
9	M	Feb. 8	Ch. 2: Step Potential
10	W	Feb. 10	Ch. 2: Step Potential
11	F	Feb. 12	Square Potential Barrier (in lieu of Delta-Function Potential)
12	M	Feb. 15	Potential Barrier & Tunneling
13	W	Feb. 17	Ch. 2: Finite Potential Well
14	F	Feb. 19	**TEST 1: Chapter -1, Chapter 2 (2.1, 2.2, 2.4, and Step potential)**
15	M	Feb. 22	Ch. 2: Finite Potential Well
16	W	Feb. 24	Ch. 2: Finite Potential Well
17	F	Feb. 26	Ch. 2: Harmonic Oscillator (*Analytic Method*)
18	M	Feb. 29	Ch. 2: Harmonic Oscillator (*Analytic Method*)
19	W	Mar. 2	Ch. 3: Hilbert Space and Operators
20	F	Mar. 4	Ch. 3: Observables, Hermitian, Adjoint, and Projection Operators
	M	Mar. 7	**SPRING BREAK**
	W	Mar. 9	
	F	Mar. 11	
21	M	Mar. 14	Ch. 3: Eigen Values and Eigen Vectors of an Operator
22	W	Mar. 16	Ch. 2: Harmonic Oscillator (*Algebraic Method*)
23	F	Mar. 18	Ch. 2: Harmonic Oscillator (*Algebraic Method*)
24	M	Mar. 21	Ch. 2: Harmonic Oscillator (*Algebraic Method*)
25	W	Mar. 23	Ch. 4: Schrodinger Equation in Spherical Coordinates
26	F	Mar. 25	Ch. 4: Schrodinger Equation in Spherical Coordinates **[TEST 2 (Take Home Exam)]**
27	M	Mar. 28	Ch. 4: Schrodinger Equation in Spherical Coordinates
28	W	Mar. 30	Ch. 4: Hydrogen Atom
29	F	Apr. 1	Ch. 4: Hydrogen Atom
30	M	Apr. 4	Ch. 4: Hydrogen Atom
31	W	Apr. 6	Ch. 4: Angular Momentum
32	F	Apr. 8	Ch. 4: Angular Momentum
33	M	Apr. 11	Ch. 4: Angular Momentum
34	W	Apr. 13	Ch. 4: Spin
35	F	Apr. 15	Ch. 4: Pauli Spin Matrices
36	M	Apr. 18	Ch. 4: Stern Gerlach/Larmour Precession
37	W	Apr. 20	Ch. 4: Addition of Angular Momenta
38	F	Apr. 21	**TEST 3: Chapter 4**
39	M	Apr. 25	Ch. 4: Clebsch-Gordon Coefficients
40	W	Apr. 27	Ch. 6: Time-Independent Perturbation Theory
41	F	Apr. 29	Ch. 6: Time-Independent Perturbation Theory
42	M	May 2	Ch. 6: Time-Independent Perturbation Theory