SIGNATURE ROUTING LOG

General Information:

Proposal Type: Course ☒ Program ☐ Other ☐

Proposal Name[1] (course prefix & number, pgm major & degree, etc.): PHY520 (change)

Proposal Contact Person Name: Kwok-Wai Ng Phone: 7-1782 Email: kwng@uky.edu

INSTRUCTIONS:
Identify the groups or individuals reviewing the proposal; note the date of approval; offer a contact person for each entry; and obtain signature of person authorized to report approval.

Internal College Approvals and Course Cross-listing Approvals:

Reviewing Group	Date Approved	Contact Person (name/phone/email)	Signature
Physics & Astronomy	8/19/10	Kwok-Wai Ng, DUS / 7-1782 / kwng@uky.edu	
Physics & Astronomy	8/19/10	Joe Brill, DGS / 7-4670 / jwbrill@uky.edu	
Physics & Astronomy	8/19/10	Mike Cavagnero / 7-6901 / mike@pa.uky.edu	
		/ /	
A&S Ed. Policy Cmte.	9/21/10	G. Murthy, Nat. Sci. / 7-4729 / ganpathy.murthy@uky.edu	
A&S Dean	9/21/10	Anna Bosch, Associate Dean / 7-6689 / bosch@uky.edu	

External-to-College Approvals:

Council	Date Approved	Signature	Approval of Revision[2]
Undergraduate Council	12/7/2010	Sharon Gill Digitally signed by Sharon Gill DN: cn=Sharon Gill, o=Undergraduate Education, ou=Undergraduate Council, email=sgill@uky.edu, c=US Date: 2010.12.10 11:16:33 -05'00'	
Graduate Council		Dr. Brian A. Jackson Digitally signed by Dr. Brian A. Jackson DN: cn=Dr. Brian A. Jackson, o=University of Kentucky, ou=Graduate School, email, c=US Date: 2011.09.14 10:20:25 -04'00'	
Health Care Colleges Council			
Senate Council Approval		University Senate Approval	

Comments:

[1] Proposal name used here must match name entered on corresponding course or program form.
[2] Councils use this space to indicate approval of revisions made subsequent to that council's approval, if deemed necessary by the revising council.

COURSE CHANGE FORM

Complete 1a – 1f & 2a – 2c. Fill out the remainder of the form as applicable for items being changed.

1. General Information.

a. Submitted by the College of: Arts and Sciences Today's Date: Aug 17, 2010

b. Department/Division: Physics and Astronomy

c. Is there a change in "ownership" of the course? YES ☐ NO ☒

If YES, what college/department will offer the course instead? _____

d. What type of change is being proposed? ☒ Major ☐ Minor[1] (place cursor here for minor change [OSC1] definition)

e. Contact Person Name: Kwok-Wai Ng Email: kwng@uky.edu Phone: 7-1782

f. Requested Effective Date: ☒ Semester Following Approval OR ☐ Specific Term[2]: _____

2. Designation and Description of Proposed Course.

a. **Current Prefix and Number:** PHY 520 *Proposed Prefix & Number:* *PHY 520*

b. **Full Title:** Introduction to Quantum Mechanics *Proposed Title:* *Introduction to Quantum Mechanics I*

c. **Current Transcript Title** (if full title is more than 40 characters): Intro to Quantum Mechanics

c. *Proposed Transcript Title (if full title is more than 40 characters):* *Intro to Quantum Mechanics I*

d. **Current Cross-listing:** ☒ N/A OR Currently[3] Cross-listed with (Prefix & Number): _____

Proposed – ☐ *ADD[3] Cross-listing (Prefix & Number):* _____

Proposed – ☐ *REMOVE[3,4] Cross-listing (Prefix & Number):* _____

e. **Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours[5] for each meeting pattern type.**

Current: 3hr/wk Lecture _____ Laboratory[5] _____ Recitation _____ Discussion _____ Indep. Study
_____ Clinical _____ Colloquium _____ Practicum _____ Research _____ Residency
_____ Seminar _____ Studio _____ Other – Please explain: _____

Proposed: *3hr/wk Lecture* _____ *Laboratory* _____ *Recitation* _____ *Discussion* _____ *Indep. Study*
_____ *Clinical* _____ *Colloquium* _____ *Practicum* _____ *Research* _____ *Residency*
_____ *Seminar* _____ *Studio* _____ *Other – Please explain:* _____

f. **Current Grading System:** ☒ Letter (A, B, C, etc.) ☐ Pass/Fail

Proposed Grading System: ☒ *Letter (A, B, C, etc.)* ☐ *Pass/Fail*

g. **Current number of credit hours:** 3 *Proposed number of credit hours:* *3*

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[1] See comment description regarding minor course change. *Minor changes are sent directly from dean's office to Senate Council Chair.* If Chair deems the change as "not minor," the form will be sent to appropriate academic Council for normal processing and contact person is informed.
[2] Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.
[3] Signature of the chair of the cross-listing department is required on the Signature Routing Log.
[4] Removing a cross-listing does not drop the other course – it merely unlinks the two courses.
[5] Generally, undergrad courses are developed such that one semester hr of credit represents 1 hr of classroom meeting per wk for a semester, exclusive of any lab meeting. Lab meeting generally represents at least two hrs per wk for a semester for 1 credit hour. (See *SR 5.2.1.*)

COURSE CHANGE FORM

h. Currently, is this course repeatable for additional credit? YES ☐ NO ☒

Proposed to be repeatable for additional credit? *YES* ☐ *NO* ☒

If YES: Maximum number of credit hours: _____

If YES: Will this course allow multiple registrations during the same semester? *YES* ☐ *NO* ☐

i. Current Course Description for Bulletin: A lecture and problem course providing an introduction to the concepts and formalism of quantum mechanics. Primary emphasis is on the Schrodinger equation and its applications including the simple harmonic oscillator, the square well, the hydrogen atom, orbital and spin angular momenta, matrix representation of two level systems. Prereq: PHY 361, MA 214; recommended: MA 322.

Proposed Course Description for Bulletin: *A lecture and problem course providing an introduction to the concepts and formalism of quantum mechanics. Primary emphasis is on the time-independent Schrodinger equation and its applications to simple systems such as the harmonic oscillator, the square-well potential, and the hydrogen atom without spin. Prereq: PHY 361, MA 214.*

j. Current Prerequisites, if any: PHY 361, MA 214.

Proposed Prerequisites, if any: *PHY 361, MA 214.*

k. Current Distance Learning(DL) Status: ☒ N/A ☐ Already approved for DL* ☐ *Please Add*[6] ☐ *Please Drop*

*If already approved for DL, the Distance Learning Form must also be submitted unless the department affirms (by checking this box ☐) that the proposed changes do not affect DL delivery.

l. Current Supplementary Teaching Component, if any: ☐ Community-Based Experience ☐ Service Learning ☐ Both

Proposed Supplementary Teaching Component: ☐ *Community-Based Experience* ☐ *Service Learning* ☐ *Both*

3. Currently, is this course taught off campus? YES ☐ NO ☒

Proposed to be taught off campus? YES ☐ NO ☒

4. Are significant changes in content/teaching objectives of the course being proposed? YES ☐ NO ☒

If YES, explain and offer brief rationale:

In talking with several of the past instructors and students it is clear that the course description is not being followed, as neither spin nor a matrix formulation of two-level systems has been discussed in recent years. Rather, the semester usually ends with a discussion of the 'spinless' hydrogen atom.

5. Course Relationship to Program(s).

a. Are there other depts and/or pgms that could be affected by the proposed change? YES ☐ NO ☒

If YES, identify the depts. and/or pgms: _____

b. Will modifying this course result in a new requirement[7] for ANY program? YES ☐ NO ☒

If YES[7], list the program(s) here: _____

6. Information to be Placed on Syllabus.

a. ☒ Check box if If changed to 400G- or 500-level course you must send in a syllabus and *you must include the*

[6] You must *also* submit the Distance Learning Form in order for the course to be considered for DL delivery.

[7] In order to change a program, a program change form must also be submitted.

changed to 400G or 500.	*differentiation* between undergraduate and graduate students by: (i) requiring additional assignments by the graduate students; and/or (ii) establishing different grading criteria in the course for graduate students. (See *SR 3.1.4.*)

University Senate Syllabi Guidelines

Phy 520 major change

General Course Information

- ☐ Full and accurate title of the course.
- ☐ Departmental and college prefix.
- ☐ Course prefix, number and section number.
- ☐ Scheduled meeting day(s), time and place.

Instructor Contact Information (if specific details are unknown, "TBA" is acceptable for one or more fields)

- ☐ Instructor name.
- ☐ Contact information for teaching/graduate assistant, etc.
- ☐ Preferred method for reaching instructor.
- ☐ Office phone number.
- ☐ Office address.
- ☐ UK email address.
- ☐ Times of regularly scheduled office hours and if prior appointment is required.

Course Description

- ☐ Reasonably detailed overview of the course.
- ☐ Student learning outcomes.
- ☐ Course goals/objectives.
- ☐ Required materials (textbook, lab materials, etc.).
- ☐ Outline of the content, which must conform to the Bulletin description.
- ☐ Summary description of the components that contribute to the determination of course grade.
- ☒ Tentative course schedule that clarifies topics, specifies assignment due dates, examination date(s).
- ☒ Final examination information: date, time, duration and location.
- ☐ For 100-, 200-, 300-, 400-, 400G- and 500-level courses, numerical grading scale and relationship to letter grades for *undergraduate* students.
- ☒ For 400G-, 500-, 600- and 700-level courses, numerical grading scale and relationship to letter grades for *graduate* students. (Graduate students cannot receive a "D" grade.)
- ☐ Relative value given to each activity in the calculation of course grades (Midterm=30%; Term Project=20%, etc.).
- ☒ Note that undergraduate students will be provided with a Midterm Evaluation (by the midterm date) of course performance based on criteria in syllabus.
- ☒ Policy on academic accommodations due to disability. Standard language is below:

  If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Course Policies

- ☒ Attendance.
- ☒ Excused absences.
- ☒ Make-up opportunities.
- ☒ Verification of absences.
- ☒ Submission of assignments.
- ☒ Academic integrity, cheating & plagiarism.
- ☒ Classroom behavior, decorum and civility.
- ☒ Professional preparations.
- ☒ Group work & student collaboration.

Physics 520 Introduction to Quantum Mechanics I
Fall 2012
Syllabus

Instructor: Wolfgang Korsch
Office Address: CP 277
Email: korsch@pa.uky.edu
Office Phone: 257-4083

Office hours: Mon. and Wed. 2 – 3 pm

Time: MWF 11:00-11:50
Place: CP287

Course Description:

A lecture and problem course providing an introduction to the concepts and formalism of quantum mechanics. Primary emphasis is on the time-independent Schrodinger equation and its applications to simple systems such as the harmonic oscillator, the square-well potential, and the hydrogen atom without spin.

Prerequisites:

PHY 361, MA 214.

Student Learning Outcomes:

After completing this course, the student will be able to:

1. Understand different quantum phenomena observed in the micro world (e.g. energy levels of hydrogen atom, electron diffraction etc.).

2. Comprehend these phenomena with the mathematical formulation of quantum mechanics.

3. Solve problems of different systems with the basic principles, namely, Schroedinger equation and the Heisenberg's uncertainty principle.

Course goals:

Physics 520 is a semester's introductory course in quantum mechanics. Knowledge of modern physics at the level of PHY228 and PHY 361 is required. The behavior of physical systems at the nanometer scale is strikingly counterintuitive to those well-versed in the study of classical

phenomena. Yet ``strange" as these systems may be, their behavior can be understood in the context of a theoretical framework with genuine predictive power. Our goal is to construct such a quantum mechanics and to investigate its consequences for physical systems operating at the nanometer scale.

Required Materials:

Required text book:	S. Gasiorowicz: Quantum Physics, 3rd Edition.
Recommended textbooks:	D. Griffiths: Quantum Mechanics, 2nd Edition. Very useful complement to Gasiorowicz.
Advanced textbooks:	C. Cohen-Tannoudji, B. Diu, F. Laloë: Quantum Mechanics, V.1. A "classic" book on quantum mechanics, very detailed.

Gasiorowicz, the required text, starts gently and continues to emphasize the empirical ramifications of the quantum phenomena described. The mathematical details are suitably presented, though the text's particular strength is the great number of physical examples it brings to bear. Griffith is the official "recommended" text; it is very comparable to Gasiorowicz and explains some of the quantum mechanical concepts in a slightly different way. This is a very nice addition to the required textbook.

Cohen-Tannoudji et al. is more complete than Gasiorowicz or Griffiths and treats the mathematical aspects of quantum mechanics in a careful and extremely clear fashion. The lectures will borrow heavily, though not exclusively, from the required and recommended texts.

A bevy of texts, of varying sophistication and coverage of applications, exist in the literature. An annotated bibliography of them has been included in the course web site. The above books, as well as selections from the bibliography just mentioned, have been placed on reserve in the Science Library.

Course web page: http://www.pa.uky.edu/~korsch/courses/phy520/fs12/

Course Activities and Assignments

The bulk of the grade in the course is associated with the problem sets, and rightly so. Working significant problem sets is necessary to develop a genuine understanding of the material. You may discuss the problems with others, and even collaborate, but you are required to write out your solutions independently. The problem sets will be issued in one-two week intervals, and late work will not be accepted. Copying homework from any other sources will be considered as plagiarism. Plagiarism and cheating in examinations will be handled according to University's rules.

Course Assignments

10 graded homeworks at 35 points each
1 Midterm Examination at 300 points
1 Final Examination at 350 points

Homework	350 points = 35% of total
Midterm exam	300 points = 30% of total
Final examination	350 points = 35% of total
Total	1000 points

Summary Description of Course Assignments

(i) Homework:

One homework set of five to six problems will be assigned about every week. You have to submit your work at the beginning of the class on the due date. Late work will not be accepted. The bulk of the grade in the course is associated with the problem sets, and rightly so. Working significant problem sets is necessary to develop a genuine understanding of the material. You may discuss the problems with others, and even collaborate, but you are required to write out your solutions independently.

Graduate students: **There will be two extra advanced problems in every set of homework for the graduate students to solve and complete. These advanced problems involve more thorough understanding of the material and will be graded base on the mathematical rigor and correctness. Each homework will have the same total (35 points) in the tabulation of final grade for both undergraduate and graduate students.**

(ii) Midterm and Final Exam:

There are one midterm exam and a final exam. Both examinations are two hours in duration. The problems in these examinations will be of similar style of the problems assigned in the homework.

Graduate students: **Both undergraduate and graduate will take the same midterm and final examinations.**

Course Grading

Grading scale for undergraduates:

80% or above	A
60% or above	B
45% or above	C
35% or above	D
Below 35% points	E

Grading scale for graduate students (**no D for Grad Students**):

80% or above	A
60 % or above	B
45% or above	C
Below 45%	E

Final Exam Information

The time of the final exam is given in the final exam schedule http://www.uky.edu/Registrar/finals.htm. The place is in the classroom where the lectures are given.

Mid-term Grade

Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (http://www.uky.edu/Registrar/AcademicCalendar.htm)

Course Policies:

Submission of Assignments:

Homework will be collected at the beginning of the class on the due date. No late homework will be accepted.

Attendance Policy:

Attendance is not mandatory, except for the midterm and final examinations. You are encouraged to attend every class since the materials we cover during class will help you prepare the homework. It is my experience that students miss class frequently will do poorly in this class.

You will receive a 0 if you miss the examination, unless you have a valid excuse. In the case of an excuse absence, a make-up test will be arranged.

Excused Absences:

Students need to notify the professor of absences prior to class when possible. S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).

Verification of Absences

Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

Academic Integrity:

Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of *Student Rights and Responsibilities* (available online http://www.uky.edu/StudentAffairs/Code/part2.html) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgement of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else's work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student's assignment involves research in outside sources of

information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Accommodations due to disability:

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Classroom Behavior Policies:

Any behavior that disturbs other students from learning during class is not welcome.

Tentative Course Schedule

(i) Course Topics

Wave packets and uncertainty relations.
The Schroedinger equation.
Simple problems. Wells, barriers, harmonic oscillator.
Mathematical tools. Ket and bra vectors, operators, state spaces.
Postulates. Basic postulates; interpretation. Time evolution.
Two-level systems. Spin 1/2 particles.
The harmonic oscillator via various techniques.
Angular momentum. Rotations, states, operators, representations.
Central potentials. H-atom, muonium.

The following topics might be addressed: scattering by a potential, spin, addition of angular momenta, systems of identical particles, perturbation theory, variational methods, H-atom fine and hyperfine structure, Zeeman and Stark effects, and the interaction of "atoms" with radiation.

(ii) Tentative schedule

Lecture#	Day	Date	Topic	Lecture	Homework
1	W	Aug,	The Emergence of Quantum	1.1 - 1.3	

		22	Physics(I)		
2	F	Aug, 24	The Emergence of Quantum Physics(II)	1.4 - 1.5	#1
3	M	Aug, 27	Wave Packets	2.1 - 2.3	
4	W	Aug, 29	Schrödinger Equation	2.4	
5	F	Aug, 31	Heisenberg Uncertainty Principle	2.5	
--	M	Sep, 03	Labor Day	--	
6	W	Sep, 05	Probability Interpretation (I)	2.5 - 2.6	#2
7	F	Sep, 07	Probability Interpretation (II)	2.6 - 2.7	
8	M	Sep, 10	Time-Independent S.E., Eigenvalues	3.1 - 3.2	
9	W	Sep, 12	Particle in a Box	3.3	
10	F	Sep, 14	Expansion Postulate	3.4	#3
11	M	Sep, 17	Momentum Eigenfunctions	3.5	
12	W	Sep, 19	Degeneracy, Symmetries	3.6	
13	F	Sep, 21	1-D Potentials: Potential Step	4.1	
14	M	Sep, 24	1-D Potentials: Potential Barrier	4.2 - 4.3	
15	W	Sep, 26	Tunneling	4.4	#4
16	F	Sep, 28	Bound States in a Potential Well	4.5	
17	M	Oct, 01	δ - Function Potentials	4.6	
18	W	Oct, 03	Harmonic Oscillator (I)	4.7	
19	F	Oct, 05	Harmonic Oscillator (II)	4.7	#5
20	M	Oct, 08	Eigenfunctions and Eigenvalues	5.1	
21	W	Oct, 10	Interpretation of Expansion Coefficients	5.2	
22	F	Oct, 12	Vector Spaces and Operators	5.3	
23	M	Oct, 15	Degeneracy and Simultaneous Observables	5.4	
24	W	Oct, 17	Summary so far	-	#6
--	R	Oct, 18	Midterm Exam, time and location: 7:00pm - 9:00pm, CP183		
25	F	Oct, 19	Time Dependence and Class. Limit	5.5	
26	M	Oct, 22	Operator Methods in Q.M.	6.1	
27	W	Oct, 24	Harmonic Oscillator: E - Spectrum	6.2	
28	F	Oct, 26	Operators and S.E.	6.3	#7
29	M	Oct, 29	Time Dependence of Operators	6.4	
30	W	Oct, 31	Angular Momentum	7.1-7.2	
31	F	Nov, 02	Spherical Coordinates (I)	7.3	
32	M	Nov, 05	Spherical Coordinates (II)	7.3 - 7.4	#8
33	W	Nov,	Schrödinger Equation in 3-D	8.1 - 8.2	

		07			
34	F	Nov, 09	Hydrogen Atom	8.2- 8.3	
35	M	Nov, 12	Energy Spectrum, Free Particle	8.3 - 8.4	
36	W	Nov, 14	Free Particle, Infinite Spherical Well	8.4 - 8.5	#9
37	F	Nov, 16	Matrix Representation of Operators	9.1	
38	M	Nov, 19	Angular Momentum Operators	9.2	
--	W	Nov, 21	General Relations in Matrix Mech.	--	
--	F	Nov, 23	Spin: Eigenstates	--	
39	M	Nov, 26	Academic Holiday	9.3	
40	W	Nov, 28	Thanksgiving Holiday	10.1	#10
41	F	Nov, 30	Intrinsic Magnetic Moment	10.2	
42	M	Dec, 03	Paramagnetic Resonance, Add. of 2 Spins	10.3-10.4	
43	W	Dec, 05	Addition of 2 Spins	10.4	#10 (due)
44	F	Dec, 07	Addition of Spin 1/2 and Orb. Ang.Mom.	10.5	
--	F	Dec, 14	Final Exam TBD		

Course evaluation

Course evaluations are an important component of our Department's instructional program. An on-line course evaluation system was developed to allow each student ample time to evaluate each component of the course and instructor, thus providing the Department with meaningful numerical scores and detailed commentary while minimizing the loss of instructional time in the classroom. To access the system, simply go the Department of Physics Web page at www.pa.uky.edu and click on the link for Course Evaluations; then follow the instructions. You will need to use your student ID# to log into the system, and this will also allow us to monitor who has filled out evaluations. However, when you log-in you will be assigned a random number that will keep all your comments and scores anonymous.