SIGNATURE ROUTING LOG

General Information:

Proposal Type: Course ☒ Program ☐ Other ☐

Proposal Name[1] (course prefix & number, pgm major & degree, etc.): PHY521 (new)

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 16:36:45 -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 10:23:10 -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.

NEW COURSE FORM

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. Contact person name: Kwok-Wai Ng Email: kwng@uky.edu Phone: 7-1782

d. Requested Effective Date: ☒ Semester following approval OR ☐ Specific Term/Year[1]: _____

2. Designation and Description of Proposed Course.

a. Prefix and Number: PHY 521

b. Full Title: INTRODUCTION TO QUANTUM MECHANICS II

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

d. To be Cross-Listed[2] with (Prefix and Number): _____

e. Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours[3] for each meeting pattern type.

3 hrs/wk Lecture _____ Laboratory[1] _____ Recitation _____ Discussion _____ Indep. Study

_____ Clinical _____ Colloquium _____ Practicum _____ Research _____ Residency

_____ Seminar _____ Studio _____ Other – Please explain: _____

f. Identify a grading system: ☒ Letter (A, B, C, etc.) ☐ Pass/Fail

g. Number of credits: 3

h. Is this course 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. Course Description for Bulletin: A continuation of PHY 520, introducing the quantum description of systems with spin, and approximation methods. Principles of quantum mechanics will be illustrated by their application to model systems selected from the fields of atomic, solid state, nuclear and particle physics. Prereq.: PHY 520.

j. Prerequisites, if any: PHY 520

k. Will this course also be offered through Distance Learning? YES[4] ☐ NO ☒

l. Supplementary teaching component, if any: ☐ Community-Based Experience ☐ Service Learning ☐ Both

3. Will this course be taught off campus? YES ☐ NO ☒

4. Frequency of Course Offering.

---

[1] Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.

[2] The chair of the cross-listing department must sign off on the Signature Routing Log.

[3] In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. Laboratory meeting, generally, represents at least two hours per week for a semester for one credit hour. (from *SR 5.2.1*)

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

NEW COURSE FORM

a. Course will be offered (check all that apply): ☐ Fall ☒ Spring ☐ Summer

b. Will the course be offered every year? YES ☒ NO ☐

If NO, explain: _____

5. Are facilities and personnel necessary for the proposed new course available? YES ☒ NO ☐

If NO, explain: _____

6. What enrollment (per section per semester) may reasonably be expected? 7 undergrads, 2 grad students

7. Anticipated Student Demand.

a. Will this course serve students primarily within the degree program? YES ☒ NO ☐

b. Will it be of interest to a significant number of students outside the degree pgm? YES ☐ NO ☒

If YES, explain: _____

8. Check the category most applicable to this course:

☒ Traditional – Offered in Corresponding Departments at Universities Elsewhere

☐ Relatively New – Now Being Widely Established

☐ Not Yet Found in Many (or Any) Other Universities

9. Course Relationship to Program(s).

a. Is this course part of a proposed new program? YES ☐ NO ☒

If YES, name the proposed new program: _____

b. Will this course be a new requirement[5] for ANY program? YES ☒ NO ☐

If YES[5], list affected programs: PHY 521 will replace the current capstone requirement for the BS degree in Physics.

10. Information to be Placed on Syllabus.

a. Is the course 400G or 500? YES ☒ NO ☐

If YES, the *differentiation for undergraduate and graduate students must be included* in the information required in ***10.b***. You must include: (i) identification of additional assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See *SR 3.1.4.*)

b. ☒ The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from ***10.a*** above) are attached.

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

Physics 521 Introduction to Quantum Mechanics II
Spring 2012
Syllabus

Instructor: Kwok-Wai Ng
Office Address: CP 171
Email: kwng@uky.edu
Office Phone: 257-1782

Office hours: Mon. and Thur. 2 – 3 pm

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

Course Description:

A continuation of PHY 520, introducing the quantum description of systems with spin, and approximation methods. Principles of quantum mechanics will be illustrated by their application to model systems selected from the fields of atomic, solid state, nuclear and particle physics.

Prerequisites:

PHY 520

Student Learning Outcomes:

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

1. To model quantum-mechanical systems with mathematical methods.

2. Establish a sure-footed calculational capability with a variety of approximation methods applied to quantum systems, and with the methods of angular momentum algebra.

3. Fully understand the nature as well as the fundamental origin of a number of physical phenomena in the fields of atomic, solid-state, and nuclear physics.and further refine problem-solving skills at the intermediate level.

Course goals:

The goal of this course is to apply the basic knowledge we acquired from PHY520 to understand the phenomena observed in actual systems like the hydrogen and helium atoms, system of identical particles, energy bands in a solid, and the principle of laser etc. This will demonstrate the importance of quantum mechanics, and how broadly it is used in modern sciences. In the

process, we will also explore more advanced topics that PHY520 does not cover, like spin and the scattering theory.

Required Materials:

Text book: Introduction to Quantum Theory, third edition, by David Park.
Course web page: http://www.pa.uky.edu/~kwng/spring2012

Course Activities and Assignments

Physics 521, a continuation of PHY 520, is an intermediate-level course in the mathematical methods of quantum mechanics. Whereas in PHY 520 we introduced the methods of wave mechanics and applied these techniques to several exactly-solvable systems, in 521 we will consider more complicated systems for which exact solutions to the Schroedinger equation cannot be found. Thus, we will consider various methods for finding approximate solutions to the wave equation. We also will introduce the quantum-mechanical concept of spin, and consider how to describe a multi-particle system composed of 'spinning' constituents. Closely related to that, we will develop methods by which both spin and orbital angular momentum can be coupled together.

The second half of the semester will be devoted to the application of these methods in developing quantum-mechanical descriptions for a number of model systems. We will begin this discussion with a complete non-relativistic description of the hydrogen atom. We then will develop an approximate description of the helium atom, and of a periodic array of atoms such as is found in a crystalline material. Finally, we will describe two nuclear systems: the deuteron, and the proton. In the case of the proton, our description will be in terms of the flavor and spin wavefunctions of the constituent quarks.

Students are not discouraged from working together on the homework assignments. However, after developing the idea, each student should work independently towards the final solution. Copying homework, either from a classmate or internet, is considered as plagiarism, which is a serious academic offense (See Academic Integrity below).

Course Assignments

Class participation at 100 points for perfect attendance
6 quizzes at 25 points each
6 graded homeworks at 25 points each
3 one hour tests at 100 points each
1 Final Examination at 200 points

Summary Description of Course Assignments

(i) Participation

Your participation score will be tabulated in proportional to the number of classes you attend.

(ii) Quizzes

Throughout the semester a series of 6 quizzes will be given – generally on the days when the homework assignments are due. These quizzes will usually consist of just 1 problem which reflects both the content and the general level of difficulty of the homework assignment.

(iii) Homework

Class work will consist of regular lectures on topics taken directly from the textbook. Students will find it advantageous to read the assigned sections of the text before they arrive for class. Homework problems will be assigned to accompany most lectures; students should put in the time and effort required to solve all of these exercises. Homework will be collected on the due date and graded. Problem solutions will be given when the graded work is returned to the students.

Also, when doing homework problems, students are encouraged not to solve integrals exclusively with one of the math software packages that are now readily available in the Department. Remember, these tools will not be available during the exams, where integrals will need to be done by hand or taken from a book.

Graduate students: **Graduate students enrolled in the course will be given one more supplementary homework problem which they will need to solve and turn in, in addition to the usual homework assignment. These extra problems will generally be somewhat more difficult, and will require some extra effort to solve. Each homework will have the same total (35 points) in the tabulation of final grade for both undergraduate and graduate students.**

(iv) Tests

Three in-class hour tests will be given at roughly 1-month intervals throughout the semester. These tests will be held in the classroom where the lectures are given and will consist of problems similar to, but not the same as, those assigned for homework. Students must bring integral tables to the tests.

(v) Final Examination

The final examination will have the same format as the in-class hour test, but twice as long in length and the students will have two hours to complete the examination. The final examination is comprehensive and covers all materials we have studied in this semester.

Graduate students: **In each of the one hour test and the final examination, there will be one harder problem which is mandatory for the graduate students to answer. Undergraduate students have the option to choose whether to answer this question or not. The total will be scaled accordingly to 100 points for the one hour test, or 200 points for the final examination.**

Course Grading

The following formula will be applied to both undergraduate and graduate students:

Participation	100 points
Homework	150 points
Quizzes	150 points
3 1-hour tests	300 points
Final examination	200 points
Total	900 points

Grading scale for undergraduates:

800 points or above	A
650 points or above	B
500 points or above	C
400 points or above	D
Below 400 points	E

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

800 points or above	A
650 points or above	B
500 points or above	C
Below 500 points	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 by 5:00pm on the due date. You can hand it to me earlier in the class, or leave it to my mail box in the Physics main office. No late homework will be accepted.

Attendance Policy:

Attendance is mandatory. Attendance is important because we will discuss many examples during class that will help you finish the homework at home. You are encouraged to participate in the discussion as we work out the examples. Discussion is one of the most effective ways to learn a new concept.

Students with an academic excuse for missing an exam should discuss it with the instructor before the exam, if possible. A grade of zero will be given for an unexcused absence from an exam. A student with an excused absence will be given the option of taking a make-up exam or receiving a 'virtual' grade based on the score of the other tests and final examination with respect to the class average. Students must complete at least two of the 1-hour exams, or their make-ups, and the final exam to be eligible to receive a passing grade for the course.

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:

Well behavior is expected. Eating, drinking, cell phone and laptop are not allowed during class. Any action that hinders the class progress is prohibited.

Tentative Course Schedule

WEEK	READING/LECTURE
1	Review of PHY 520 (Chs. 1-6)
2,3,4	Ch. 7: Perturbation Methods Stationary states; First-order methods; Energy degeneracy; WKB; Variational method; Non-stationary states; Periodic perturbations
5,6,7	Ch. 9: Spin and Isospin Spin-1/2; Magnetic fields; Spin addition; Angular momentum coupling; Density matrix; Isospin
8	Ch. 12: Identical Particles Symmetry and Antisymmetry; Helium spectrum; Neutrons and protons
9,10	Ch. 16: Atomic Hydrogen Fine structure; Zeeman splitting; 21-cm line; Lamb shift
11	Ch. 17: Helium Ground state; Excited states
12	Ch. 15: Electrons in a Periodic Lattice Periodic potential; Effective mass; Conductivity
13	Ch. 19: The Deuteron Central potential; Tensor interaction
14	Ch. 20: Quarks and Baryons Flavor and spin wavefunctions; Magnetic moments

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

Physics 521 is a heavy-duty course – one that will require a lot of work on your part throughout the entire semester to achieve mastery. If you find that you are falling behind and not able to understand the material or do the homework problems, you should seek assistance quickly. The material is strongly cumulative, so it simply will not be possible to dismiss your misunderstandings and try to move on. The instructor is available during office hours, and at

many other times by appointment, to help you learn this material. Take advantage of that opportunity.

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.