Chair: Tracy Christofero | **GC#6: Course Addition**

Request for Graduate Course Addition

1. Prepare one paper copy with all signatures and supporting material and forward to the Graduate Council Chair.
2. E-mail one identical PDF copy to the Graduate Council Chair. If attachments included, please merge into a single file.
3. ***The Graduate Council cannot process this application until it has received both the PDF copy and the signed hard copy.***

College: College of Science Dept/Division: Physics Alpha Designator/Number: PHY 642 (•) Graded ( ) CR/NC

Contact Person: Huong Nguen Phone: x6-2756

NEW COURSE DATA:

New Course Title: Advanced Quantum Mechanics

Alpha Designator/Number: P H Y 6 4 2

Title Abbreviation: A d v a n c e d Q u a n t u m M e c h a n i c s

(Limit of 25 characters and spaces)

Course Catalog Description: (Limit of 30 words)
This course covers advanced topics of quantum mechanics at the graduate level. Topics include fundamental issues, approximation methods and applications.

Co-requisite(s): PHY 630 First Term to be Offered: Spring 2019

Prerequisite(s): PHY 630 Credit Hours: 4

Course(s) being deleted in place of this addition (*must submit course deletion form*): Not Applicable

COS DEAN'S OFFICE
2018 NOV -2 P 4:23

Signatures: if disapproved at any level, do not sign. Return to previous signer with recommendation attached.

Dept. Chair/Division Head	Date 11/1/2018
Registrar 400801	Date 11/2/18
College Curriculum Chair	Date 12/9/2018
Graduate Council Chair	Date

Form updated 10/2011

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College: College of Science Department/Division: Department of Physics Alpha Designator/Number: PHY 642

Provide complete information regarding the new course addition for each topic listed below. Before routing this form, a complete syllabus also must be attached addressing the items listed on the first page of this form.

1. FACULTY: Identify by name the faculty in your department/division who may teach this course.

Huong Nguyen
Maria Babiuc Hamilton
Jon Saken
Sean McBride

2. DUPLICATION: If a question of possible duplication occurs, attach a copy of the correspondence sent to the appropriate department(s) describing the proposal. Enter "***Not Applicable***" if not applicable.

Not Applicable

3. REQUIRED COURSE: If this course will be required by another deparment(s), identify it/them by name. Enter "***Not Applicable***" if not applicable.

Not Applicable

4. AGREEMENTS: If there are any agreements required to provide clinical experiences, attach the details and the signed agreement. Enter "***Not Applicable***" if not applicable.

Not Applicable

5. ADDITIONAL RESOURCE REQUIREMENTS: If your department requires additional faculty, equipment, or specialized materials to teach this course, attach an estimate of the time and money required to secure these items. (Note: Approval of this form does not imply approval for additional resources.) Enter "***Not Applicable***" if not applicable.

Not Applicable

6. COURSE OBJECTIVES: (May be submitted as a separate document)

The primary objective of this course is to build the understanding of physical concepts and knowledge of mathematical methods of quantum mechanics. On this foundation the course will offer the study of more complicated systems and interactions. The secondary objective is to develop analytical skills for solving realistic quantum systems.

7. COURSE OUTLINE (May be submitted as a separate document)

1. Mathematical Introduction
2. Review of Classical Mechanics
3. All is not Well with Classical Mechanics
4. The Postulates - a General Discussion
5. Simple Problems in One Dimension
6. The Classical Limit
7. The Harmonic Oscillator
8. The Heisenberg Uncertainty Relations
9. Systems with N Degrees of Freedom
10. Symmetries and their Consequences
11. Rotational Invariance and Angular Momentum
12. The Hydrogen Atom
13. Spin
14. Addition of Angular Momenta
15. The Variational and WKB Methods
16. Time-Independence Perturbation Theory
17. Time-Dependence Perturbation Theory
18. Scattering Theory
19. The Dirac Equation

8. SAMPLE TEXT(S) WITH AUTHOR(S) AND PUBLICATION DATES (May be submitted as a separate document)

Principles of Quantum Mechanics, by R. Shankar, 2nd Ed., Springer 2014

9. EXAMPLE OF INSTRUCTIONAL METHODS (Lecture, lab, internship)

Lecture 2 times a week, with examples and in-class problem solving.

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10. EXAMPLE EVALUATION METHODS (CHAPTER, MIDTERM, FINAL, PROJECTS, ETC.)

4 quizzes, 2 Midterms, one project and a final

11. ADDITIONAL GRADUATE REQUIREMENTS IF LISTED AS AN UNDERGRADUATE/GRADUATE COURSE

Not Applicable

12. PROVIDE COMPLETE BIBLIOGRAPHY (May be submitted as a separate document)

1. Shankar R., Principles of Quantum Mechanics, 2nd Ed., Springer 2014 ISBN 9780306447907
2. Sakurai J.J., Modern Quantum Mechanics, Addison-Wesley 1994, ISBN 9780201539295
3. Landau L.D., & Lifshitz, Quantum Mechanics, Butterworth-Heinerman, 3rd #d, 1981, ISBN 9780750635394
4. Claude Cohen-Tannoudji, Bernard Diu, Frank Laloe, 1st Ed, Wiley-VCH 1992 ISBN 9780471569527

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Please insert in the text box below your course summary information for the Graduate Council agenda. Please enter the information exactly in this way (including headings):

Department:
Course Number and Title:
Catalog Description:
Prerequisites:
First Term Offered:
Credit Hours:

Department: Department of Physics
Course Number: PHY 642
Course Title: Advanced Quantum Mechanics
Catalog Description: This course covers advanced concepts of quantum mechanics at the graduate level. Topics include fundamental issues, approximation methods and applications.
Prerequisites/Corequisites: PHY 630
First Term Offered: Spring 2019
Credit Hours: 4

PHY 642 SYLLABUS

Course Title/Number	PHY 642: Advanced Quantum Mechanics
Semester/Year	Spring 2019
Days/Time	T &R, 4:00-5:50
Location	S281
Instructor	Que Huong Nguyen
Office	S 251
Phone	62756
E-Mail	nguyenh@marshall.edu
Office/Hours	1-3pm T&R
University Policies	By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy be going to www.marshall.edu/academic-affairs and clicking on "Marshall University Policies." Or, you can access the policies directly by going to http://www.marshall.edu/academic-affairs/?page_id=802 Academic Dishonesty/ Excused Absence Policy for Undergraduates/ Computing Services Acceptable Use/ Inclement Weather/ Dead Week/ Students with Disabilities/ Academic Forgiveness/ Academic Probation and Suspension/ Academic Rights and Responsibilities of Students/ Affirmative Action/ Sexual Harassment

Course Description: From Catalog

The course covers advanced concepts of quantum mechanics at the graduate level. Topics include fundamental issues, approximation methods and applications

Goals & Outcomes:

Course Student Learning Outcomes	**How students will practice each outcome in this Course**	**How student achievement of each outcome will be assessed in this Course**
Students will learn theoretical background of fundamental concepts	theory will be discussed in class, examples will be solved as classwork.	Students will be given quizzes on each part they learn.
Students will learn different approximation methods and problem solving techniques for each method.	Students will practice the techniques through classwork and homework. Homework will be assigned every week.	Two semester exams will be given to assess student knowledge.
Student will concentrate on physical application of each method.	Students will be introduced to problems different areas of physics in class. Students are expected to be attentive in class and	Final exam will be accumulative.

	participate in the classroom discussion.	
Students will apply the techniques and strategies to solve problems in realistic systems	Students will work on real physics problems Graduate students will work on a graduate project using these methods.	Evaluation of student work will be based on homework, quiz and exam performance, and also graduate project for graduate students.

Required Texts, Additional Reading, and Other Materials

1. Required Textbook: *Shankar R, Principle of Quantum Mechanics, 2nd Ed, Springer 2014*
2. *Sakurai J.J. Modern Quantum Mechanics, Addison-Wesley 1994*
3. *Landau L.D. & Lifshitz, Quantum Mechanics, 3rd ed, 1994*
4. *Claude-Cohen-Tannoudji, Bernard Diu, Frank Laloe, Willey-VCH 1992*

Course Requirements / Due Dates

There will be 2 midterms and one final. Quizzes will be given every 3- week period

1. Exam 1: TBA
2. Exam 2: TBA
3. Project; Due a week before final
4. Final: TBA

Grading Policy

Homework:	10%
Quizzes	15%
Exam I	15%
Exam II	15 %
Project	20%
Final Exam	25%

Attendance Policy

Students are expected to attend all scheduled classes. Lectures and class discussions are vital for learning and understanding. Any absence from exams and quizzes can be excused only if the instructor is informed in advance with reasonable excuses. See University policy above.

Course Schedule

Shankar R, Principle of Quantum Mechanics, 2nd Ed, Springer 2014

- Mathematical Introduction
- Review of Classical Mechanics
- All Is Not Well with Classical Mechanics
- The Postulates—a General Discussion
- Simple Problems in One Dimension
- The Classical Limit
- The Harmonic Oscillator
- The Heisenberg Uncertainty Relations
- Systems with N Degrees of Freedom
- Symmetries and Their Consequences
- Rotational Invariance and Angular Momentum
- The Hydrogen Atom
- Spin
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- The Variational and WKB Methods
- Time-Independent Perturbation Theory
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- The Dirac Equation