### PHYS 530A: QUANTUM MECHANICS II

SYLLABUS (2018 Spring) Department of Physics, Southern Illinois University–Carbondale Last updated: February 7, 2018

# **1** General information:

Instructor: K. V. Shajesh Office: Neckers 491, Tel.: +1-618-453-5212. Email: shajesh@siu.edu Web-page: http://www.physics.siu.edu/~shajesh Class meetings: TR 4:00-5:15PM, in Neckers 410. Office hours: MWF 4:00-5:30 PM; TR 11:30 AM-12:15 PM.

# 2 Prerequisites:

Should be familiar with the contents of an undergraduate level course on Quantum Mechanics, an equivalent of PHYS-430 and PHYS-440. Familiarity with the following topics will be assumed: representation of linear transformations using matrices, complex analysis, partial differential equations.

# 3 Course description

We shall introduce the measurement algebra in quantum mechanics in the context of Stern-Gerlach experiment. Harmonic oscillator will be treated completely. Generators of infinitesimal Galilean transformations, including spin, will be introduced, and the Hamilton's equations of motion will be derived. Angular momentum will be covered in detail, and the rotation transformation function for an arbitrary spin will be derived. Addition of angular momentum will be discussed and the hydrogen atom states will be built out of addition of two "angular momentum". Zeeman effect and Stark effect will be discussed. In the following semester we will discuss perturbation theory, scattering theory, and Dirac equation.

# References

- 1. Lecture notes for PHYS-530A Quantum Mechanics II (2014 Spring), available at http://www.physics.siu.edu/~shajesh/tc/201401-SIU-P530A/.
- 2. Principles of Quantum Mechanics, by P. A. M. Dirac. (Available in http://archive.org.)
- 3. Quantum Mechanics: Symbolism of Atomic Measurements, by J. Schwinger, edited by B.-G. Englert.
- 4. Schwinger's Quantum Action Principle, by K. A. Milton, http://arxiv.org/abs/1503.08091.
- 5. Introduction to Quantum Mechanics, lecture notes by K. A. Milton, available at http://www.nhn.ou.edu/~milton/p3803-12.html and http://www.nhn.ou.edu/~milton/p4803-12.html.
- 6. Quantum Mechanics, by L. I. Schiff.
- 7. Principles of Quantum Mechanics, by R. Shankar.
- 8. Quantum Mechanics, by E. Merzbacher.
- 9. Modern Quantum Mechanics, by J. J. Sakurai.
- 10. Quantum Mechanics, by C. Cohen-Tannoudji, B. Diu, and F. Laloë.

### Webpage

Lecture notes and homework will be posted at http://www.physics.siu.edu/~shajesh. It is adviced to download relevant materials to your computer, because the website (or the internet) could be occasionally down.

# 4 Course work

# Evaluation

| Homework                        | 40%          |
|---------------------------------|--------------|
| Midterm Exams $(2 \times 20\%)$ | 40%          |
| Extra Credit Work               | y in Eq. (2) |
| Final Exam                      | 20%          |

## Homework

Homework will be assigned regularly. Students are encouraged to discuss homework problems with their peers, refer to additional books, and use resources on the Internet. But, each student should submit their own work describing detailed steps of their thought process.

## Exams

Three examinations (including the Final Exam) will be administered.

| Midterm Exam 1 | February 22 (Thursday)        |
|----------------|-------------------------------|
| Midterm Exam 2 | April 5 (Thursday)            |
| Final Exam     | May 8 (Tuesday, 5:00-7:00 PM) |

The midterm exams will assess you on concepts covered in lectures and homework. All the midterm exams will be cumulative, but you are recommended to concentrate more on topics covered in the later part of the semester.

# Grading

The grading will be done on a scale of 0-100. This Raw Score x (out of 100) should be used to assess your knowledge in the subject. The raw score will be converted to the university scale using the following formula for Your Score x',

$$x' = x + a(100 - x),\tag{1}$$

where  $0 \le a \le 1$  is the curve parameter. The curve parameter a is calculated as

$$a = a_0 \frac{(1+0.50y)}{2},\tag{2}$$

where  $a_0$  is the primary curve parameter that is decided by the instructor. The curve parameter can be boosted by submitting problems assigned for Extra Credit, y being the total score in Extra Credit submissions (out of 1.00). For example, for a = 0.50, a Raw Score of 60 will lead to Your Score of 80.

# 5 Syllabus Attachment

The Provost Office has created a "Syllabus Attachment" to assist the student. It lists and provides web links for many elements that are important for a student. Kindly find it attached.

# Syllabus Attachment

# Spring 2018

# IMPORTANT DATES \*

Last day to add full-term course (without Dean's signature): ......01/21/2018 Last day to withdraw from the University with a full refund: ......01/26/2018 Last day to drop a full-term course for a credit/refund:.....01/28/2018 Last day to drop a full-term course (W grade, no refund): ......04/01/2018 The Final exam schedule will be posted the third week of class.

Please verify the above dates with the Registrar calendar and find more detailed information on deadlines at http://registrar.siu.edu/calendars. For add/drop dates that apply to shorter-than-full-term courses, please look at the Schedule of Classes search results at <a href="http://registrar.siu.edu/schedclass/index.php">http://registrar.siu.edu/schedclass/index.php</a>

#### SPRING SEMESTER HOLIDAYS

Martin Luther King, Jr.'s Birthday Holiday 01/15/2018 Spring Vacation 03/10-03/18/2018

#### WITHDRAWAL POLICY ~ Undergraduate only

Students who officially register for a session must officially withdraw from that registration in a timely manner to avoid being charged as well as receiving a failing grade for those classes. An official withdrawal must be initiated by the student, or on behalf of the student through the academic unit, and be processed by the Registrar's office. For the proper procedures to follow when dropping courses and when withdrawing from SIU visit: http://registrar.siu.edu/students/withdrawal.php

#### **INCOMPLETE POLICY~** Undergraduate only

An INC grade may be assigned when, for reasons beyond their control, students engaged in passing work are unable to complete all class assignments for the course. An INC must be changed to a completed grade within one full semester (undergraduates), and one full year (graduate students), from the close of the term in which the course was taken or graduation, whichever occurs first. Should the student fail to complete the remaining course requirements within the time period designated, the incomplete will be converted to a grade of F and such grade will be computed in the student's grade point average. For more information visit:

http://registrar.siu.edu/grades/incomplete.php

#### REPEAT POLICY

An undergraduate student may, for the purpose of raising a grade, enroll in a course for credit more than once. For students receiving a letter grade of A, B, C, D, or F, the course repetition must occur at Southern Illinois University Carbondale. Effective for courses taken Summer 2013 or later, only the most recent (last) grade will be calculated in the overall GPA and count toward hours earned.

This policy will be applied to all transferrable credit in that only the last grade will be used to calculate grade point average. Only those courses taken at the same institution are considered repeats under this policy. See full policy at http://registrar.siu.edu/students/repeatclasses.php

#### **GRADUATE POLICIES**

Graduate policies often vary from Undergraduate policies. To view the applicable DIVERSITY policies for graduate students, please refer to the graduate catalog at http://gradschool.siu.edu/about-us/grad-catalog/

#### DISABILITY POLICY

Disability Support Services provides the required academic and programmatic support services to students with permanent and temporary disabilities. DSS provides centralized coordination and referral services. To utilize DSS services, students must contact DSS to open cases. The process involves interviews, reviews of studentsupplied documentation, and completion of Disability Accommodation Agreements. http://disabilityservices.siu.edu/

#### PLAGIARISM

See the Student Conduct Code http://srr.siu.edu/student-conduct-code/

ADVISEMENT: http://advisement.siu.edu/

#### MISSION STATEMENT FOR SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

SIU embraces a unique tradition of access and opportunity, inclusive excellence, innovation in research and creativity, and outstanding teaching focused on nurturing student success. As a nationally ranked public research university and regional economic catalyst, we create and exchange knowledge to shape future leaders, improve our communities, and transform lives.

#### SAFETY AWARENESS FACTS AND EDUCATION

Title IX makes it clear that violence and harassment based on sex and gender is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: http://safe.siu.edu

#### SALUKI CARES

The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in any type of distressphysical, emotional, financial, or personal. By working closely with faculty, staff, students and their families, SIU will continue to display a culture of care and demonstrate to our students and their families that they are an important part of the community. For Information on Saluki Cares: call (618) 453-1492, email siucares@siu.edu, or http://salukicares.siu.edu/

#### SIU'S EARLY WARNING INTERVENTION PROGRAM (EWIP)

Students enrolled in courses participating in SIU's Early Warning Intervention Program might be contacted by University staff during a semester. More information can be found at the Core Curriculum's Overview webpage: http://corecurriculum.siu.edu/program-overview/

#### **EMERGENCY PROCEDURES**

We ask that you become familiar with Emergency Preparedness @ SIU. Emergency response information is available on posters in buildings on campus, on the Emergency Preparedness @ SIU website, and though text and email alerts. To register for alerts visit: http://emergency.siu.edu/

#### STUDENT MULTICULTURAL RESOURCE CENTER

The Student Multicultural Resource Center serves as a catalyst for inclusion. diversity and innovation. As the Center continues its work, we are here to ensure that you think, grow and succeed. We encourage you to stop by the Center, located in Grinnell Commons, to see the resources available and discover ways you can get involved on the campus. Visit us at http:// inclusiveexcellence.siu.edu/

#### LEARNING AND SUPPORT SERVICES

Help is within reach. Learning support services offers free tutoring on campus and math labs. To find more information please visit the Center for Learning and Support Services website:

Tutoring : http://tutoring.siu.edu/

Math Labs http://math.siu.edu/courses/course-help.php

#### WRITING CENTER

The Writing Center offers free tutoring services to all SIU students and faculty. To find a Center or Schedule an appointment please visit: http://write.siu.edu/

Southern Illinois University Carbondale's goal is to provide a welcoming campus where all of our students, faculty and staff can study and work in a respectful, positive environment free from racism and intimidation. For more information visit: http://diversity.siu.edu/#

#### MILITARY COMMUNITY

There are complexities of being a member of the military community and also a student, and military and veteran related developments can complicate academic life. If you are a member of the military community and in need of accommodations please visit Veterans Services at http://veterans.siu.edu/

SIU ONLINE: https://online.siu.edu/

Need help with an issue? Please visit SALUKI SOLUTION FINDER at http://solutionfinder.siu.edu/