

Physics 472 & 572 • Quantum Theory II • Spring 2017

Prerequisites PHYS 371 and PHYS 305

Lecturer Prof. Johann (Jan) Rafelski (PAS 386D).

Classroom and meeting time MWF 10:00 AM – 10:50 AM, PAS 414.

Office hours: Wednesday's 4-7PM and by appointment, PAS386/D.

Office hour **Recitation Session:** Wednesday's at 6PM-6:50PM, location PAS 386 session in which we all practice solutions of problems set in homework and/or prepare for test.

SYLLABUS: For 80-90% of course contents I follow the book: *Introduction to Quantum Mechanics*, 2/E by David J. Griffiths, ISBN: 0-13-111892-7 (Prentice Hall 2005) – Note that this is the old edition and not the costly CUP edition of this year. *Note that the similar looking “International Edition” has permuted sequence of chapters, my remarks below refer to the US edition.* Additional material covering the other 10-20% of the course will be provided by Email as pdf-handout. Spring 2017 topics:

1. A brief review of selected topics from PHYS371/Chapters 1-4 of textbook including: matrix formulation of quantum mechanics, theory of angular momentum, spin, addition of angular momenta.
2. Multi-particle systems (Chapter 5): Pauli exclusion principle and atomic structure with applications to the understanding of the periodic table; fermi gases and statistical distributions with applications in astrophysics and quark phase of matter
3. Stationary state perturbation theory (Chapter 6), with applications such as atomic level fine structure, and splitting of atomic levels in magnetic fields (Zeeman effect).
4. Qualitative methods a) Feynman-Hellman theorem (section 6); b) variational methods with application to Helium and molecules (section 7); c) the WKB approximating method (section 8) with application to determining wave function where it is small e.g. for quantum tunneling phenomena; d) Born Oppenheimer Approximation (section 10 in two steps, qualitative here and after we do section 9 return to justify).
5. Time dependent perturbation theory (section 9), and applications (section 10) Will obtain the so Fermi's golden rule and connect to atomic transition rates. Return to Born Oppenheimer Approximation.
6. A short look at quantum scattering theory (section 11) with application to discovery of nuclear elementary particles structure
7. Research frontier QM topics time permitting (entanglement is an example)

Grading: 20% Homework; 40% = 2x20 1h-Midterms; 40% Final.

you can expect: > 90% A; >80% B; >70% C; >60% D;

Class performance may dictate lower percentages that will be determined and documented by the instructor - a procedure commonly called 'curving'

Important dates:

Midterm tests (preliminary schedule): Mondays, February 13, and April 3;

Final UA-scheduled Friday May 5, 2016 10:30 am - 12:30 pm, see:

<http://www.registrar.arizona.edu/courses/spring-2017?audience=students&cat1=10&cat2=31>

Homework: about 10-12 assignments on weekly or biweekly basis comprising typically 4 problems from book or class work. Collaboration and discussion among students is encouraged, participation in recitation session is expected, individual problem solutions are required. Typically home work will be set on Friday by Email and is due following Friday at beginning of class.

Absence policies: Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

Regular participation in all class activities is required. A missed exam due to an excused absence that is documented ahead of time by the student will be substituted with a make-up exam or an alternative arrangement at the discretion of the instructor. The UAs policy concerning Class Attendance, Participation, and Administrative Drops is available at:

<http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

Accommodations: Students requiring accommodations in testing should consult with and/or inform me during the first week of classes. Policy for 'regrading': All work to be considered for a regrade must be submitted at most 48h after its return to the student.

Other policies

1) <http://policy.arizona.edu/human-resources/religious-accommodation-policy>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable. Please notify lecturer well ahead of time about your absences based on this policy.

2) Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored – notify lecturer well ahead of time. See:

<https://deanofstudents.arizona.edu/absences>

3) Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at

<http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and

<http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal>

4) **Honors Credit:** Students wishing to contract this course for Honors Credit should email me to set up an appointment to discuss the terms of the contact. Information on Honors Contracts can be found at <http://www.honors.arizona.edu/faculty-and-advisors/contracts>.

Threatening Behavior Policy: The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself:

<http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>

Code of Academic Integrity: Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See:

<http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

UA Nondiscrimination and Anti-harassment Policy: The University is committed to creating and maintaining an environment free of discrimination:

<http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Subject to Change Statement: Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

PHYS472 Schedule v2.0 of 01/30/2017 Office hours 4-7PM Wednesday; 6-7PM recitation session Spring 2017

Sun	Monday	Tues	Wednesday	Thursday	Friday	Sat
Jan 8 Wk 1	9	10	11 #1 10AM	12	13#2 10AM	Jan 14
Jan 15 Wk 2	16 MLK	17	18#3 10AM 6PM-Recitation	19	20#4 10AM HW 1 due	Jan 21
Jan 22 Wk 3	23#5 10AM	24	25#6 10AM 6PM-Recitation	26	27#7 10AM HW 2 due	Jan 28
Jan 29 Wk 4	30#8 10AM	Jan 31	Feb 1#9 10AM 6PM-Recitation	2	3#10 10AM HW3 due	Feb 4
Feb 5 Wk 5	6#11 10AM	7	8#12 10AM 6PM-Recitation	9	10#13 10AM HW4 due	Feb 11
Feb 12 Wk 6	13#14 10AM	14	15#15 10AM 6PM-TestPrep	16	17#16 10AM TEST 1	Feb 18
Feb 19 Wk 7	20#17 10AM	21	22#18 10AM 6PM-Recitation	23	24#19 10AM HW 5 due	Feb 25
Feb 26 Wk 8	27#20 10AM	28	Mar 1#21 10AM 6PM-Recitation	2	3#22 10AM HW 6 due	Mar 4
Mar 5 Wk9	6#23 10AM	7	8#24 10AM 6PM-Recitation	9	10#25 10AM HW 7 due	Mar 11
Mar 12	13 Spring Break	14 Spring Break	15 Spring Break	16 Spring Break	17 Spring Break	Mar 18
Mar 19 Wk 10	20#26 10AM	21	22#27 10AM 6PM-Recitation	23	24#28 10AM HW 8 due	Mar 25
Mar 26 Wk 11	27#29 10AM	28	29#30 10AM 6PM-Recitation	30	31#31 10AM HW 9 due	Apr 1
Apr 2 Wk 12	3#32 10AM	4	5#33 10AM 6PM-TestPrep	6	7#34 10AM TEST 2	Apr 8
Apr 9 Wk 13	10#35 10AM	11	12#36 10AM 6PM-Recitation	13	14#37 10AM HW10 due	Apr 15
Apr 16 Wk 14	17#38 10AM	18	19#39 10AM 6PM-Recitation	20	21#40 10AM HW11 due	Apr 22
Apr 23 Wk 15	24#41 10AM	25	26#42 10AM 6PM-Recitation	27	28#43 10AM HW 12 due	Apr 29
Apr 30 Wk 16	May 1#44 10AM Review	2	3#45 10AM Review	4 Reading	5 Final: 10:30-12:30	May 6
May 7	8 Finals	9 Finals	10 Finals	11 Finals	12 Graduation	May 13

Last drop with no grade awarded: PHYS472=Jan 25; PHYS 572=Feb 7 (no 572 student enrolled)

Last drop with Grade W awarded March 28