EP 455 – Quantum Physics
Embry-Riddle University
Fall 2012

Instructor: M. Anthony Reynolds
email: `reynodb2@erau.edu`
web: `http://faculty.erau.edu/reynolds/ep455`
phone: (386) 226-7752
office: Lehman 313
office hours: M-Th, 2:00-4:00, Lehman 313

Required texts: *Introduction to Quantum Mechanics*, 2ed, by Griffiths
Schaum's Outlines – Quantum Mechanics, 2ed, by Peleg, Pnini, Zaarur, and Hecht
Supplementary texts: *Quantum Mechanics,* by Mandl
Introductory Quantum Mechanics, by Liboff
"*Hyperphysics*" `http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html`

Percentage system:

1 final exam	20%
3 tests	60% (20% each)
Problems	12%
Note-taking	8%

Grading scale:

A	90% –
B	75% – 89%
C	60% – 74%
D	50% – 59%

IMPORTANT NOTE

Listening to lectures is not enough (*you retain only 10% of what you hear …*). All processes of learning are somehow connected to active participation, and the learning of physics is no exception. Therefore, it is imperative that you work diligently at your own desk (*… 80% of what you practice …*). However, this does not mean that you should only work alone. I encourage you to form study groups and collaborate with your classmates (*… and 90% of what you teach to others!*).

---

* This syllabus incorporates all existing University policies, especially those sections of the *Student Handbook* pertaining to academic integrity, civility, and respect. *

Course Description: This course is a study of the Schrodinger equation in 1 and 3 dimensions and its solutions for step potentials, the harmonic oscillator, and the hydrogen atom; operators and their matrix representations; Dirac bracket formalism, angular momentum and spin, spin-orbit interaction; identical particles and exchange symmetries; classical and quantum statistical distributions.
Prerequisites: EP 440 or instructor consent

Learning Outcomes:

1. Quantitatively comprehend the basic physical principles of quantum mechanics and their applications to quantitative predictions of the operations of microscopic systems.
2. Set up the Hamiltonian for different systems and their interactions to different force fields.
3. Quantitatively understand operators, their commutation relations and applications to atomic, molecular and nuclear systems.
4. Set up and solve the Schrodinger equation for different microscopic systems and events. Apply this to atomic, molecular and nuclear structures.
5. Quantitatively interpret wave functions, probability amplitudes and probability.
6. Understand quantum mechanical behavior of identical particles and the effects of half integral and integral spin on their population distribution as a function of their energy.
7. Calculate angular momenta and their quantization.
8. Apply knowledge of college-level mathematics for defining and solving problems.
9. Communicate ideas in non-written form, such as through oral presentations and visual media.
10. Conduct and report research accurately and in accordance with professional standards.

RULES

1. Arrive on time; depart on time.
2. Bring enthusiasm to each class.
3. No eating, no cell phones.

Final Exam

Comprehensive; two-hour; closed book; closed notes.
Tools: pen or pencil.
Date: Tuesday, 11 Dec, 19:15 – 21:15.

Tests

One-hour; closed book; closed notes.
Tools: pen or pencil.
Dates: Fri 21 Sep, Fri 26 Oct, Mon 3 Dec.

Problems

Approximately 1-2 problems each week; solved at the board.
Graded on completeness, correctness and effort.

Note-taking

Responsible for taking notes approximately once every 2 weeks.

All assignments are due at the *beginning* of class on the due date, after which they will be considered late and the score will be reduced by 50%. After the beginning of the *next* class period, they will not be accepted.

General study habits

Repetition is critical for creating long-term memories. A good method for learning is the following sequence: read, listen, write, re-read, re-write, practice, and review. The textbook should be read THREE times: read once before class, read deeply (at least) once after class, and once as a review. In addition, you do not read textbooks as you would the newspaper. You must work through the examples, all mathematical steps should be confirmed, and you should write notes in the margins (it is your book, you can write in it!).

Notes

Taking notes during lecture is important – but you must review and re-copy those notes after class for them to be useful. In this class, there will be one "note taker" for each class period, who will then recopy (neatly) those notes and pass them out to the entire class. It is important that you get into the habit studying every day.

Study Groups

I strongly suggest that you form study groups. "For most individuals, learning is most effectively carried out via social interactions." (Ed Redish)

Problem Solving

Solving problems is **critical** to your success in this course. An excellent method to prepare for the exams is to attempt problems at home in an exam-type environment. That is, once you have solved a group of problems, put aside the solutions and pretend that they are questions on an exam – attempt to solve them again, but without any help. Solve problems according to the following rules of coherence and readability:

- Describe *briefly*, but in clear and complete sentences, the basic principles used to solve the problem and explain the basic equations that are used in the solution [DO NOT simply rewrite the question]. This is the most important component of coherence and full credit will not be given for any problem solution that does not contain such a description.
- If a physical situation is discussed in the problem, draw an appropriate diagram.
- Identify in words, or by clear references to the diagram, all the symbols you use.
- Work through the problem symbolically, getting a simplified symbolic answer, and only substitute numbers (if appropriate at all) at the very end.
- If you obtain an explicit numerical solution, comment on whether the value you get is reasonable.
- Put boxes around your final answers.
- Write up the problem sets neatly.

Do not simply copy another student's work, and do not simply copy from the solutions manual, but I recommend that you form study groups and work together. This can help you through difficult sections and problems. I encourage you to discuss, argue, arm-wrestle, and finally master the problems. However, I expect you to write up your solutions individually, showing your own insights.
