SYLLABUS

Course Code	*Course Num.*	*Course Name*	*Credit Hours*	*Lec.*	*Lab.*	*Tut.*	*Private study*	*Pre-requisites*	*Course Level*	*Language*
PHY	**462**	**Atomic Physics**	**3**	**2**	**0**	**2**	**4**	**PHY 312**	**7**	**English**

A. Course Description

Using the quantum approach to the subject of atomic physics, this course keeps the mathematics to the minimum needed for a clear and comprehensive understanding of the material. Beginning with an introduction and treatment of atomic structure, the course goes on to deal with quantum mechanics, atomic spectra and the theory of interaction between atoms and radiation. This course covers the following topics: the hydrogen atom, the hydrogen atom-fine structure, two-electron atoms, many-electron atoms, interaction with static external fields, interaction with static external fields, and hyperfine structure.

B. Course Outcomes

At the end of this course the student will be able to**:**

1. Understand the concepts of a good quantum number and simultaneous observability.
2. Understand the quantum numbers, including their physical significance, and quantum mechanical states of the hydrogen atom.
3. Understand time independent perturbation theory including its derivation and be able to apply it to simple systems, including the Stark-Effect and Zeeman Effect.
4. Know about the origins of fine structure in atomic spectra.
5. Understand the exchange degeneracy and how this affects the excited states of helium.
6. Understand the Periodic table from the viewpoint of the electronic structure.
7. Understand and be able to apply to simple cases time dependent perturbation theory.
8. Understand the derivation of and be able to apply the selection rules for the interaction of electric dipole radiation and atoms.

C. References

Required Textbook

Woodgate G. K., ***Elementary Atomic Structure****,* McGraw-Hill (1983).

Other references

- Jones D. G. C., ***Atomic Physics,*** Chapman and Hall (1997).
- Foot C.J., ***Atomic Physics,*** Oxford (2005).

Course Website: http://www.imamm.org/

D. Topics Outline

1. ***The hydrogen atom:*** *The Schrödinger equation, stationary states, expectation values, solution of Schrödinger's equation for a Coulomb field, the quantum numbers and, the hydrogen energy spectrum (*Contact hours*: 12).*
2. ***The hydrogen atom-fine structure:*** *Electron spin, the interaction terms, the vector model, The Lamb shift (*Contact hours*: 8).*

3. ***Two-electron atoms:*** *Electrostatic interaction and exchange degeneracy, the ground state of helium, the excited states of helium, electron spin functions and the Pauli exclusion principle, The periodic system (*Contact hours*: 10).*
4. ***Many-electron atoms:*** *The central field, Thomas-Fermi potential, The LS coupling approximation, Allowed terms in LS coupling, fine structure in LS coupling, the j-j coupling approximation (*Contact hours*: 10).*
5. ***Interaction with static external fields:*** *Zeeman Effect in LS coupling, quadratic Stark effect, linear Stark effect (*Contact hours*: 8).*
6. ***Hyperfine structure:*** *Magnetic dipole interaction, determination of nuclear spin from magnetic hyperfine structure, determination of from magnetic hyperfine structure, magnetic hyperfine structure in two-electron spectra, electric quadrupole interaction, Zeeman effect of hyperfine structure (*Contact hours*: 12).*

E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm 1:** 6th or 7th week.
- **Midterm 2:** 11th or 12th week.
- **Quizzes & Homeworks:** During the semester.
- **Final Exam:** 16th week.

Your course grade will be based on your semester work as follows:

Midterm 1: 20 %	**Midterm 2:** 20 %	**Final Exam:** 40 %
Quizzes, Homework, Attendance & Participation: 20 %		

The grading distribution:

A+	A	B+	B	C+	C	D+	D	F
[95, 100]	[90, 95)	[85, 90)	[80, 85)	[75, 80)	[70, 75)	[65, 70)	[60, 65)	[0, 60)

G. Student Workload

#	Teaching/Learning activities	Contact hours	Frequency	Total contact hours	Self-study hours	Total self-study hours	Student learning time
1	Lecture	2	15	30	1	15	45
2	Tutorial	2	15	30	1	15	45
3	Lab\practical	0	0	0	0	0	0
4	Homework	0	4	0	2	8	8
5	Quiz	0.5	2	1	1	2	3
6	Midterm	1.5	2	3	5	10	13
7	Final Exam	2	1	2	12	12	14
Total				**66**		**62**	**128**

The independent self-study is approximately 4 hours per week.

H. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

Executive Rules for Study Regulations and Exams
goo.gl/ykm7t3