Course Title	Course Code	Number of Study Hours			Year	Level	Prerequisites
		Theoretical	Laboratory	Credit			
Atomic Physics and Spectroscopy	342PHYS	3	2	4	3rd	6th	312PHYS

(1) Brief Course Description

The course provides background knowledge of major discoveries and models relating to the atom such as Rutherford model, Bohr model and interpretation of the spectral series of the hydrogen atom, Sommerfeld model, quantum theory achievements (energy levels, Quantum numbers, electron spin and orbital angular momentum, and orbital-spin interaction). The course also covers the rules of atomic emission as well as the effect of magnetic and electric field on the atom. A series of compulsory practical exercises are undertaken to demonstrate the principles involved.

(2) Course Objectives

This course is designed to provide students with:

- The fundamental of the atomic structure.
- The essential concepts of orbital motion, spin of the electron and fine structure
- The effect of magnetic and electric field on the atom
- The spectral line emission and related rules.
- Practical exercises are undertaken.

(3) Course Contents

Theoretical Part:

- **Atom Concept:** Rutherford model, Bohr postulates and Bohr model of hydrogen atom**,** Spectral series of hydrogen atom (Balmer, Lyman, Paschen, Brackett and Pfund), Spectrum of hydrogen like atoms, and Sommerfeld model.
- **Orbital, Spin and Fine structure**: Quantum theory achievements (energy levels - quantum numbers), Magnetic moment of the orbital motion, Spin and magnetic moment of the electron, Stern and Gerlach experiment, Spin-Orbit interaction (LS coupling) and total angular momentum, Fine structure , and Term diagram, Pauli's exclusion principle, Selection Rule, and The Lamb shift.
- **Atoms in a magnetic and Electric Fields**: Electron spin resonance, Normal Zeeman effect Anomalous Zeeman effect , The Paschen Back effect, Stark effect, Factors affecting spectral line broadening (Doppler's width – Stark's width), and Detection of Spectral line.
- **X-ray emission and internal shells:** X-ray radiation from outer shells**,** X-ray Bremsstrahlung spectra**,** X-ray **c**haracteristic radiation**.**

Experimental Part:

- Balmer series of hydrogen and Hg visible spectrum Experiment.
- Grating spectrometer (Hg, Na) Experiment.
- X–ray Emission Experiment.
- Frank–Hertz experiment.
- Zeeman effect Experiment.

(4) Assessment Criteria

- Periodic Exams: 20%
- Oral, Student Activity and Essay: 10%
- Laboratory Work: 20%
- Final Exam: 50%

(5) Course Teaching Strategies

- Lectures, Reports and Essay Assignments, Homeworks, and Web-based assignments.

(6) Text Book

- The Physics of Atom and Quanta; Hermann Hacken, and Hans Christoph Wolf; 7th ed Springer-Verlage 2005.

(7) Reference Books:

- Introduction to Atomic and Nuclear Physics; H. Semat, Holt McDougal; 5th edition 1972.
- Atomic Physics; C. Foot, Oxford University Press, USA; 1st edition, 2005.