هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	**Atomic Physics and Spectroscopy**
Course Code:	**342PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**
Version:	**2022**
Last Revision Date:	**20 December 2022**

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	4				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered: 11/4					
4. Course General 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					
5. Pre-requirements for this course (if any):341Phys					
6. Co- requirements for this course (if any):non					
7. Course Main Objective(s) **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.					

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	**60**	**91%**
2.	E-learning		
3.	Hybrid ● Traditional classroom ● E-learning	**6**	**9%**
4.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	33
2.	Laboratory/Studio	20
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0
	Total	53

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	**State** Bohr postulates, Pauli's exclusion principle, Quantum numbers, Selection rule,	**PLO1.1**	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion	**Direct:** (formative and summative): In-class interactive questioning, quizzes, written exams **Indirect:** student Survey
1.2	**Outline** Rutherford atom model, difficulties of Rutherford model, Bohr postulates, the failure of Bohr model, effect of magnetic field on atom, effect of electric field on atom, factors affecting	**PLO1.2**	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion	**Direct:** (formative and summative): In-class interactive questioning, quizzes, written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	spectral line broadening, and detection of spectral line.			**Indirect:** student Survey
1.3	**Describe** Rutherford experiment for atom explanation, and Stern-Gerlach experiment.	**PLO1.2**	1.3	**Describe** Rutherford experiment for atom explanation, and Stern-Gerlach experiment.
2.0	Skills			
2.1	**Solve** problems related to the wavelengths of spectral lines of different series of hydrogen atoms, Rydberg constant, the orbital and spin magnetic moment of an electron, Zeeman splitting, LS coupling, and wavelengths of x-ray lines.	**PLO2.1**	2.1	**Solve** problems related to the wavelengths of spectral lines of different series of hydrogen atom, Rydberg constant, the orbital and spin magnetic moment of an electron, Zeeman splitting, LS coupling, and wavelengths of x-ray lines.
2.2	**Derive** the total energy for hydrogen atom based on Bohr Model, based on Sommerfeld model, radius of different orbit	**PLO2.2**	2.2	**Derive** the total energy for hydrogen atom based on

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	in Bohr atom, velocity of electron in energy levels in Bohr atom, the orbital magnetic moment of an electron for Bohr atom and reveals by quantum mechanics.			Bohr Model, based on Sommerfeld model, radius of different orbit in Bohr atom, velocity of electron in energy levels in Bohr atom, the orbital magnetic moment of an electron for Bohr atom and reveals by quantum mechanics.
2.3	**Discuss** Electron spin resonance, Normal Zeeman effect, Anomalous Zeeman effect, Paschen Back effect, Stark effect.	**PLO2.2**	2.3	**Discuss** Electron spin resonance, Normal Zeeman effect, Anomalous Zeeman effect, Paschen Back effect, Stark effect.
2.4	**Differentiate** between Normal Zeeman effect, and Anomalous Zeeman, and between Anomalous Zeeman effect, and Paschen Back effect.	**PLO2.2**	2.4	**Differentiate** between Normal Zeeman effect, and Anomalous

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
				Zeeman, and between Anomalous Zeeman effect, and Paschen Back effect.
3.0	Values, autonomy, and responsibility			
3.1	**Show** effective collaboration and bear individual responsibility during group work in lab and/or assignments and practice safety in lab	**PLO3.1 PLO3.3**	Interactive and Group discussion, expository and discovery teaching	**Direct:** (formative and summative): In-class interactive questioning, quizzes, written exams **Indirect:** student Survey
3.2	**Develop** competencies in communication, critical thinking and reporting during lab work, interactive discussion and group assignments.	**PLO3.5**	Interactive and Group discussion, expository and discovery teaching	**Direct:** (formative and summative): In-class interactive questioning, quizzes, written exams **Indirect:** student Survey

C. Course Content

No	List of Topics	Contact Hours
1. 1	**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.	**10**
2. 2	**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.	**10**
3. 3	**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.	**9**
4	**X-ray emission and internal shells:** X-ray radiation from outer shells, X-ray Bremsstrahlung spectra, X-ray characteristic radiation.	**3**
5	Review	**1**
Total		33

Experimental Part:

No	List of Topics	Contact Hours
1	Balmer series of hydrogen and Hg visible spectrum Experiment.	**3**
2	Grating spectrometer (Hg, Na) Experiment.	**7**
3	X–ray Emission Experiment.	**3**
4	Frank–Hertz experiment.	**3**
5	Zeeman effect Experiment.	**2**
7	Review	**2**
Total		20

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework assignment- Contribution to interactive discussion	2	2 % (2)
2.	1 Quiz	4	2 % (2)
3.	Homework assignment- Contribution to the interactive discussion	5	2 % (2)
4.	Midterm-Exam	6	15 % (15)
5.	Quiz 2	7	2 % (2)
6.	Homework assignment- Contribution to the interactive discussion- Group work essay or Project discussion	7	2 % (2)
7.	Laboratory Work	11	25 % (25)
8.	Final Examination	12	50 % (50)

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	**The Physics of Atom and Quanta; Hermann Hacken, and Hans Christoph Wolf; 7th ed Springer-Verlage 2005.**
Supportive References	**- Introduction to Atomic and Nuclear Physics; H. Semat, Holt McDougal; 5th edition 1972.** **- Atomic Physics; C. Foot, Oxford University Press, USA; 1st edition, 2005.**
Electronic Materials	https://www.britannica.com/science/atomic-physics http://www.atomicarchive.com/Physics/Physics1.shtml https://opentextbc.ca/physicstestbook2/chapter/introduction-to-atomic-physics/
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
Technology equipment (projector, smart board, software)	Multimedia Projector
Other equipment (depending on the nature of the specialty)	Nuclear Physics Laboratory

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peers, and Program Leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/Indirect
Quality of learning resources	Instructor	Direct/Indirect
The extent to which CLOs have been achieved	Students, Faculty members	Indirect (CES)- Indirect peer evaluation
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	DEPARTMENT BOARD
REFERENCE NO.	PHYS2304
DATE	28/2/2023