



# Course Specification

## (Bachelor)

Course Title: **Atomic and Molecular Physics**

Course Code: **PHYS 0443**

Program: **Physics Program**

Department: **Physics Department**

College: **College of Science**

Institution: **Majmaah University**

Version: **1**

Last Revision Date: **30/12/2024**



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## A. General information about the course:

### 1. Course Identification

1. Credit hours: ( 3, 0, 0 )

#### 2. Course type

A.  University  College  Department  Track  Others  
 B.  Required  Elective

3. Level/year at which this course is offered: ( 4.)

#### 4. Course General Description:

This course will enlighten the knowledge of atoms and molecules and build up the pre-requisite knowledge for all science and engineering field. it covers the spectra emission or absorption of Atoms and molecules physics through two partes: The first half of the course atomic structure and the interaction between atoms and electromagnetic waves. Comparing between atomic emission spectroscopy and atomic absorption spectroscopy; Optical spectroscopy, Atomic spectrum, Quanti-zation of hydrogen atom, Atomic emission / absorption spectrophotometry atomic spectroscopy, Spectroscopy of inner electrons. Zeeman's effect, Sodium spectrum, Effect of magnetic field on the energy levels of atom. Theory of magnetic energy, Anomalous Zeeman's effect and Lande splitting factor.

The second half of the course deals with the binding of atoms into molecules, Molecular Spectra of diatomic molecules, Vibrational energy levels in both classical mechanics and quantum mechanics. Rotational spectra of diatomic molecule in gaseous state and rotational energy levels, Molecular spectra; harmonic Oscillator, Non Rigid Rotator, Infrared Vibration, Rotation spectra, spectrum,

#### 5. Pre-requirements for this course (if any):

(PHYS 0342)

#### 6. Co-requisites for this course (if any):

no

#### 7. Course Main Objective(s):

1	Describe the atomic emission / absorption spectrophotometry and molecular spectroscopy
2	Describe the atomic spectra of one and two valance electron atoms
3	Describe the molecular structure of the diatomic molecules
4	Explain the change in behavior of atoms in external applied electric and magnetic field.
5	Explain rotational, vibrational, and electronic spectra of molecules.

### 2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100



No	Mode of Instruction	Contact Hours	Percentage
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>• Traditional classroom</li> <li>• E-learning</li> </ul>		
4	Distance learning		

### 3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
<b>Total</b>		<b>45</b>

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	List different types of atomic spectra and related instrumentation.	<b>K1</b>	Lecture Exercise Quizzes Problem Solving	Standard Exams Assignments
1.2	Describe theories explaining the structure of atoms and the origin of the observed spectra.	<b>K1</b>		
...	Identify atomic effect such as space quantization and Zeeman effect.	<b>K2</b>		
	Describe the molecular bonding and molecular energies.	<b>K2</b>		





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	Memorize different technique used in laser and applications.	<b>K2</b>		
<b>2.0</b>	<b>Skills</b>			
2.1	Collect general information about some about some atomic spectra related topics.	<b>S2</b>	Lecture Exercise Quizes Problem Solving Group Discution	Standard Exams Assignments Supervisor evaluation
2.2	Use the mathematical modelling, experimental work in understanding physics phenomena.	<b>S2</b>		
2.3	Apply the gained mathematical and experimental knowledge in any physical related topic.	<b>S2</b>		
2.4	Operate questions and communicate with teacher through solve problems and work in groups	<b>S4</b>		
<b>3.0</b>	<b>Values, autonomy, and responsibility</b>			
3.1	Work in a group and learn time management.	<b>V2</b>	Making students aware of time management in completing their assignments	Internal evaluation
...	Present a short report in a written form and orally using appropriate scientific language.	<b>V3</b>		

### C. Course Content

No	List of Topics	Contact Hours
1.	➤ Basic principles experimental observations of spectroscopy	3
2.	➤ Structure of an atom with Thomson model, Rutherford model and Bohr model	6
3	➤ Quantum mechanical treatment of atomic structure	6
4	➤ Structure of an atom with effect of electric and magnetic fields	6
5	➤ LS coupling and total angular momentum for many electron atom	6
6	➤ Molecular structure: Introduction to molecular physics with a discussion of binding in diatomic molecules. An introduction about	9





	covalent and ionic bondings, and the LCAO method (Linear Combination of Atomic Orbital)	
7	➤ Physics of Vibration and Rotation molecules	9
<b>Total</b>		<b>45</b>

## D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid- term 1*	6 or 7 week	15
2.	HW	Every unit of Topics	10
3.	Mid-term 2*	11 or 12 week	15
4	Quiz	5 and 10 week	10
5	Small project	13 week	10
6	Final exam *	15 or 16 week	40
total			100

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

## E. Learning Resources and Facilities

### 1. References and Learning Resources

<b>Essential References</b>	The Physics of Atoms and Quanta, ISBN-10: 3-540-20807-0, H. Haken and H. Wolf, Springer, 7 <sup>th</sup> Ed. (2005)
<b>Supportive References</b>	Concepts of Modern Physics, 0072448482, Arthur Beiser, McGraw-Hill Higher Education, 6 <sup>th</sup> Ed. (2003)
<b>Electronic Materials</b>	Saudi Digital Library (SDL)
<b>Other Learning Materials</b>	Excel software for drawing graphs.

### 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	<i>Classrooms, data show, Smart Board, software</i>
<b>Technology equipment</b> (projector, smart board, software)	<i>Computer Lab. and internet lab.</i>
<b>Other equipment</b> (depending on the nature of the specialty)	<i>Library, Wi-Fi internet connections</i>





## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	<i>Internal Reviewer committee</i>	<i>Direct</i>
Effectiveness of Students assessment	<i>Students</i>	<i>Indirect</i>
Quality of learning resources	<i>Peer Reviewer</i>	<i>Direct</i>
The extent to which CLOs have been achieved	<i>Internal Reviewer committee</i>	<i>Direct</i>
Other		

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	DEPARTMENT COUNCIL
<b>REFERENCE NO.</b>	<b>16</b>
<b>DATE</b>	30/12/2024

