Course Specification

(Postgraduate Programs)

Course Title:	**Atomic and Molecular Physics**
Course Code:	**PHYS620**
Program:	**Master of Science in Physics**
Department:	**Physical Sciences**
College:	**Science**
Institution:	**Jazan University**
Version:	
Last Revision Date:	20/4/2024

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A. General information about the course:

1. Course Identification:

1. Credit hours: (3)				
2. Course type				
A.	☐University	☐ College	☒ Department	☐Track
B.	☐Required		☒ Elective	
3. Level/year at which this course is offered: (Level 2 or 3/Year 1 or 2**)**				
4. Course general Description: This course is designed to provide full understanding of macroscopic properties of matter based on its microscopic composition of the constituent atoms. The course includes: The hydrogen like atoms, atoms with more than one electron, emission and absorption of electromagnetic radiation by atoms, and modern developments in atomic and molecular Physics.				
5. Pre-requirements for this course (if any)**: Non**				
6. co-requirements for this course (if any)**: Non**				
7. Course Main Objective(s):				

The main objectives of this course are focused on the following:

- **Review the hydrogen atom and atoms with more than one electron system.**
- **Provide the basics of emission and absorption of radiation by atoms.**
- **Provide the basics of emission and absorption of radiation by atoms.**
- **Explain electronic states and spectra of polyatomic molecules.**
- **Explore different experimental techniques in atomic and molecular physics.**
- **Discuss a brief account on modern developments in atomic and molecular physics.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
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)……**	
	Total	45

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: **Upon completing the course students will be able to**			
1.1	**State** Concepts, criteria's and theories	**PLO1.1**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration –	**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
			Problem based learning	**Indirect**: student survey
1.2	**Define** basic principles – fundamental laws in the course	**PLO1.1**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
1.3	**Discuss** physics Phenomena and their applications in the course	**PLO1.2**	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.0	Skills: **Upon completing the course students will be able to**			
2.1	**Solve** problems related to the course	**PLO2.1**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	**Derive** relationships between various physics parameters – dependence of parameters	**PLO2.1**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.3	**Develop** competencies in communication, critical thinking and reporting during the course work.	**PLO2.2**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
3.0	Values, autonomy, and responsibility: **Upon completing the course students will be able to**			
3.1	**Adopt** some practices of self and long-life learning in the field of Atomic and Molecular Physics and its important applications through some essays and case studies	**PLO3.2**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey

C. Course Content:

No	List of Topics	Contact Hours
1.	**Review of hydrogen atom**	**4.5**
2.	**Atoms with more than one electron:** Helium atom, principle of the electron shell for larger atoms, alkali atoms, excited atomic states, exotic atoms, emission and absorption of radiation by atoms.	**10.5**
3.	**Diatomic molecules:** H_2 Molecule, Electronic states, Molecular binding, Rotation and vibration states	**10.5**
4.	**Polyatomic molecules:** Electronic states, rotation and vibrations, spectra, Clusters and chemical reactions, Molecular dynamics and wave packets.	**10.5**
5.	**Experimental techniques in atomic and molecular physics:** Microwave spectroscopy, Infrared spectroscopy, Raman spectroscopy, Spectroscopy with synchrotron radiation, Electron spectroscopy, Modern developments in atomic and molecular physics.	**9**
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**First mid-term exam**	**6**	**15**
2.	**Activities (home-works, tests, class activities)**	**Over the semester**	**20**
3.	**Second mid-term exam**	**12**	**15**
4.	**Final Exam**	**16**	**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	Wolfgang Demtröder, Atoms, Molecules and Photons, 2nd edition,(Springer, 2010).
Supportive References	1- H. Hakenand H.C.Wolf, The Physics of Atoms and Quanta,(Springer,2005). 2- Bransden and Joachain, Physics of Atoms and Molecules, (Longman Scientific and Technical 1990).

Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Class room- if possible room for interactive discussion (round table)
Technology equipment (projector, smart board, software)	Data show- smart board
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	Indirect
Extend of achievement of course learning outcomes	Instructor	Direct/Indirect
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Department Council**
REFERENCE NO.	**Psci2415**
DATE	**1/10/2024**