Course Specification
(Bachelor)

Course Title	**Atomic and Molecular Spectroscopy**
Course Code:	**PHY 1447**
Program:	**Bachelor of Science in Physics.**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	1
Last Revision Date:	***26/09/2024***

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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	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 7 or 8/ Year4)					
4. Course General Description:					
The main aim of this course is to introduce the student to spectroscopy in a clear manner which avoids, as far as possible, the mathematical aspects of the subject. After explaining the theory behind spectroscopy, the course then goes on to look at the different techniques, such as rotational, vibrational and electronic spectroscopy. It encompasses both high resolution (structural) and low resolution (analytical) spectroscopy, demonstrating their close interrelationship.					
5. Pre-requirements for this course (if any)**:**					
Atomic Physics, PHY 1362					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Give the basic principles and applications of atomic and molecular spectroscopy.**
- **Familiarize students with fundamental concepts of atomic structure.**
- **Acquaint with the different types of molecular spectra.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		60

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
1.0	**Knowledge and understanding**			
1.1	**Recognize the scientific method of inquiry to conclude concepts atomic structure.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe the scientific method of inquiry to conclude concepts of Structure of molecules.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Outline the scientific method of inquiry to conclude concepts of emission and absorption of electromagnetic radiation.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.4	**State the scientific method of inquiry to conclude concepts of Spectrum.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.5	**Describe the scientific method of inquiry to conclude concepts of combined techniques.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.6	**Recognize the scientific method of inquiry to conclude concepts of the Spectroscopy.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying Atomic and Molecular Spectroscopy**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	▪ Problem classes and group tutorial. ▪ Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner orally, and using IT for acquiring and analyzing information.**	**S4, S5**	• Lectures. • Class discussions. • Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Exams. ▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. • Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**Atomic Structure:** Historical notes, Models of atoms, spectral line series, orbitals electron shells, energy term of atoms.	8
2.	**Structure of molecules:** Quantum states of molecules, molecular orbital's, vibration and rotation energetic levels.	8
3.	**Emission and absorption of electromagnetic radiation:** Quantum transitions, Spontaneous and simulated emission, absorption of radiation, spectral line, Röntgen and characteristic radiation.	8
4.	**Spectrum:** Splitting of energy levels, Zeeman and Stark effect Separation methods: classification of separation methods, principles of chromatography, liquid and gas chromatography.	8

5.	**Combined techniques:** Mass spectrometer, Fourier transformation in mass spectrometry.	8
6.	**Spectroscopy:** Classification of methods, basic principles of spectroscopy. Emission, absorption and diffraction spectroscopic methods, basic blocks of a spectrometric line, Lambert-Beer Law.	8
7.	**Atomic absorption spectroscopy:** Basic scheme, sources of radiation, atomizer, monochromator, applications of AAS.	6
8.	**Atomic emission spectroscopy:** Basic scheme, sources of radiation, inductively coupled plasma, fluorescence spectroscopy, fluorescence quenching.	6
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (class quizzes, homework, solving problems, etc.....)**	**weekly**	**10 %**
2.	**Midterm Exam 1**	**6th week**	**25 %**
3.	**Midterm Exam 2**	**12th week**	**25 %**
4.	**Final Exam**	**16th week**	**40 %**

*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	- Michael Holl J., ***Basic Atomic and Molecular Spectroscopy,*** Royal Society of Chemistry (2002).
Supportive References	- Svanberg S., ***Atomic and Molecular Spectroscopy: Basic Aspects and Practical Applications,*** 4th Edition, Springer (2001).
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- Classrooms. - Labs.

Items	Resources
Technology equipment (projector, smart board, software)	- Classroom equipped with a whiteboard and a projector.
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students** **Second examiner**	**Indirect (The students complete the evaluation forms at the end of term. Final exam is evaluated by the second examiner)**
Effectiveness of Students assessment	**Instructors**	**Direct (exams, HW, project, …)**
Quality of learning resources	**Faculty** **Students**	**indirect (surveys)**
The extent to which CLOs have been achieved	**Instructors** **Program Leaders**	**Direct (excel sheet)**
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**Quality Unit-Physics Department**
REFERENCE NO.	**Department council No. 06**
DATE	**26/09/2024**