هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	Atomic and Molecular Spectroscopy
Course Code:	2034105-3
Program:	Bachelor in Physics
Department:	Physics Department
College:	College of Science
Institution:	Taif University
Version:	3
Last Revision Date:	24 May 2022

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A. General information about the course:

1. Course Identification

1. Credit hours: (3 hours)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (7th Level/ 4th Year)					
4. Course general Description:					
The first half of this course deals principally with atomic structure and the interaction between atoms and electromagnetic waves. Comparing between atomic emission and atomic absorption spectra. Rydberg equation, Atomic models, Quantum numbers. Electron configuration of atoms. Spin orbit coupling and Zeeman effect. 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. IR spectroscopy.					
5. Pre-requirements for this course (if any):					
Quantum Physics (1) 2033202-3 Modern physics 2033105-4					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					
The aim of the course is that the student at the end of the course shall: – Describe the atomic emission/absorption spectrophotometry and molecular spectroscopy – Describe the atomic spectra of one and two valance electron atoms. – Explain the change in behavior of atoms in external applied electric and magnetic field. – Explain rotational, vibrational, electronic and Raman spectra of molecules. – Describe electron spin and nuclear magnetic resonance spectroscopy and their applications.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)**	0
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**			
1.1	Describe the atomic spectra of one and two valance electron atoms.	K2	Lecture	Written exam and Homework
1.2	Recognize theories and experiments explaining the structure of atoms and molecules and the origin of the observed spectra.	K3	Lecture Discussion	Written exam
2.0	**Skills**			
2.1	Can calculate the energy spectrum of fine and hyperfine interactions, Zeeman effect and Stark's effect.	S1	Lecture	Written exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	Develop problem solving skills in spectroscopy physics	S2	Lecture and Group discussion	Written exam and Homework
3.0	**Values, autonomy, and responsibility**			
3.1	Show responsibility for working independently and for continuous improvement of personal capacities.	V1	Group discussion	Homework and reports

C. Course Content

No	List of Topics	Contact Hours
1	Definition of the spectra, types (emission and absorption) and forms of the spectra (continuous, band and line) Electromagnetic waves, interaction of electromagnetic waves with matter, the main parts of the spectrophotometer (sources, dispersion units, samples compartment and detection unit)	4
2	The main atomic models (Thomson, Rutherford and Bohr) Hydrogen atom review	3
3	Calculation of the energies, wavelengths, frequencies and wave numbers of the Hydrogen atom series, the reasons for failure of Bohr model	4
4	Quantum numbers and atomic structure review, Pauli's Exclusion principles and Hund's rules, degeneracy, couples angular momentum	4
5	Spin – orbit (LS) coupling and fine structure, hyperfine interactions	3
6	Spectral consequences of the fine structure, selection rules, Helium energy levels	3
7	Atoms and field interactions, dipole interactions	3
8	Normal and anomalous Zeeman's effect, Lande – g – factor	3
9	Spectral consequences of the applied fields, Stark effect	3
10	Atom - atom Interactions, Bonding: Van der Waals, covalence	3
11	New degrees of freedom rotations and vibrations	3
12	Molecular electronic spectra	3
13	Experimental probes ultra violet (UV), visible (Vis)	3
14	Infrared (IR) and Raman spectroscopy, Selection rules	3
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Activities (assignments)	Periodically	20%
2.	Midterm exam 1	8th	15%
3.	Midterm exam 2	13th	15%
4.	Final exam	17th	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	1- Atomic spectra and atomic structure, Herzberg, G., Dover Publications, New York, 1944. 2- Introduction to atomic spectra, White, H. E. McGraw-Hill Book Company, Inc. New York and London, 1934.
Supportive References	1- Atomic and molecular spectroscopy; basic aspects and practical applications Svanberg S., springer, 2003. 2- Modern spectroscopy, Hollas, J. M., John Willy and Sons, Ltd. 2004.
Electronic Materials	Web Sites on the internet that are relevant to the topics of the course & general physics websites such as : 1- http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html 2- http://www.hazemsakeek.info/magazine
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with min 50 seats
Technology equipment (projector, smart board, software)	– Software (MATLAB, Origin .....) – data show – Smart Board
Other equipment (depending on the nature of the specialty)	NA

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of Students assessment	Faculty Program coordinator	Direct
Quality of learning resources	Students Faculty	Indirect
The extent to which CLOs have been achieved	Faculty Program coordinator	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**PHYSICS DEPARTMENT COUNCIL**
REFERENCE NO.	**NO. 4-45**
DATE	**27/09/2023 (12/03/1445)**

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