



UNSW Course Outline

ZPEM3103 Quantum Theory and Applications in Spectroscopy - 2024

Published on the 11 Feb 2024

General Course Information

Course Code : ZPEM3103

Year : 2024

Term : Semester 1

Teaching Period : Z1

Is a multi-term course? : No

Faculty : UNSW Canberra

Academic Unit : UC Science

Delivery Mode : In Person

Delivery Format : Standard

Delivery Location : UNSW Canberra at ADFA

Campus : UNSW Canberra

Study Level : Undergraduate

Units of Credit : 6

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

Since the work of Isaac Newton, the development of quantum theory at the beginning of the 20th

century was the greatest advance in physical science. Arguably, quantum mechanics has now become the most successful theory of all time. This course for upper level students of physics and chemistry presents a brief history of quantum theory, followed by an introduction to the standard formalism of quantum mechanics, e.g. the postulates of quantum theory, the properties of linear operators, Dirac notation etc. The gained knowledge is then applied to the physics of atoms and molecules and a range of spectroscopic methods, including electron spin resonance, nuclear magnetic resonance and rotational, vibrational and electronic spectroscopy.

Course Aims

A rigorous introduction to quantum theory and its use in determining the energies, structures, dimensions and other properties of quantum systems such as atoms and molecules. The learned principles are applied in the field of spectroscopy. The laboratory work includes spectroscopic experiments for the determination of molecular energies and dimensions, comparing results with theoretical calculations.

Relationship to Other Courses

Some Maths is required for this course at the Maths 1a 1b level. Some basic knowledge of chemistry is needed too.

Course Learning Outcomes

Course Learning Outcomes
CL01 : Understand the foundations of quantum mechanics
CL02 : Understand the foundations of molecular spectroscopy

Course Learning Outcomes	Assessment Item
CL01 : Understand the foundations of quantum mechanics	<ul style="list-style-type: none">• Class test 1• Laboratory• Final Exam
CL02 : Understand the foundations of molecular spectroscopy	<ul style="list-style-type: none">• Class test 2• Laboratory• Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

whiteboard

powerpoint presentation

in class demonstrations

various books

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class test 1	20%	Start Date: 03/04/2024 10:00 AM Due Date: 03/04/2024 11:20 AM Post Date: 03/04/2024 10:00 AM
Laboratory	20%	Start Date: Not Applicable Due Date: 07/06/2024 05:00 PM
Class test 2	30%	Start Date: 29/05/2024 10:07 AM Due Date: 29/05/2024 11:20 AM Post Date: 05/06/2024 10:00 AM
Final Exam	30%	Start Date: exam period Due Date: exam period

Assessment Details

Class test 1

Assessment Overview

Postulates of quantum theory plus simple quantum systems

Marked classtest

Course Learning Outcomes

- CL01 : Understand the foundations of quantum mechanics

Detailed Assessment Description

Very first part of lecture material will be assessed. Simple equations such as photon energy and energy conversion will be required.

In class test. Allowed resources are scientific pocket calculator only.

The class test itself is worth 18%. The balance of 2% is awarded to the completion of practice questions that must be submitted as hardcopies by 24 March 2024. The practice question mark (maximum of 2%) mark is added to the class test mark (maximum of 18%).

Assessment Length

1 h in class test

Submission notes

handwritten only

Assessment information

N/A

Assignment submission Turnitin type

Not Applicable

Laboratory

Assessment Overview

Laboratory exercises with marked lab reports.

Course Learning Outcomes

- CL01 : Understand the foundations of quantum mechanics
- CL02 : Understand the foundations of molecular spectroscopy

Detailed Assessment Description

Attendance is compulsory. Then participation and lab reports will be marked. Resources: lab manual and literature.

Assessment Length

concise lab reports are required

Submission notes

typed lab reports

Assessment information

N/A

Assignment submission Turnitin type

Not Applicable

Class test 2

Assessment Overview

Applications of quantum theory in spectroscopy. Marked class test.

Course Learning Outcomes

- CL02 : Understand the foundations of molecular spectroscopy

Detailed Assessment Description

Some basic calculations are required in this class test such as rotational constants, Huang-Rhys parameters, vibrational spectroscopy etc. Pocket calculator is the only resource that is allowed.

Assessment Length

1 h

Submission notes

hand written only

Assessment information

N/A

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

Marked final exam comprehensively covering course.

Course Learning Outcomes

- CL01 : Understand the foundations of quantum mechanics
- CL02 : Understand the foundations of molecular spectroscopy

Detailed Assessment Description

The final exam assesses the total content of the course i.e. the knowledge that was necessary for the two class tests is required.

Assessment Length

2 h examination

Submission notes

test book handwritten only

Assessment information

N/A

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Clear study guides will be provided for the assessments. The complexity of the assessments gradually increases with the course progressing.

Grading Basis

Standard

Requirements to pass course

50% mark for total assessment.

Course Schedule

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

Lectures: Monday 1400-1500; Tuesday: 1300-1400; Wednesday 1000-1100

Labs: Wednesday 1300-1700; Thursday 1300-1700

Course Resources

Prescribed Resources

Lecture notes

Recommended Resources

Many resources such as excellent textbooks are available.

Additional Costs

none

Course Evaluation and Development

MyExperience. Feedback will be acted upon.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Hans Riesen		Building 22, room 212	+61 2 5114 5052	Monday to Friday 7.30-1200; please send email for appointment	No	Yes

Other Useful Information

Academic Information

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of each course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups (where applicable). Student opinions really do make a difference. Refer to the Moodle site for your course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct.

<https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf>

Equitable Learning Services (ELS)

Students living with neurodivergent, physical and/or mental health conditions or caring for someone with these conditions may be eligible for support through the Equitable Learning Services team. Equitable Learning Services is a free and confidential service that provides practical support to ensure your mental or physical health conditions do not adversely affect

your studies.

Our team of dedicated **Equitable Learning Facilitators (ELFs)** are here to assist you through this process. We offer a number of services to make your education at UNSW easier and more equitable.

Further information about ELS for currently enrolled students can be found at: <https://www.student.unsw.edu.au/equitable-learning>

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct. Find relevant information at: [Student Code of Conduct \(unsw.edu.au\)](https://www.student.unsw.edu.au/student-code-of-conduct)

Plagiarism undermines academic integrity and is not tolerated at UNSW. It is defined as using the words or ideas of others and passing them off as your own, and can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

<https://student.unsw.edu.au/plagiarism>

Submission of Assessment Tasks

Special Consideration

Special Consideration is the process for assessing and addressing the impact on students of short-term events, that are beyond the control of the student, and that affect performance in a specific assessment task or tasks.

Applications for Special Consideration will be accepted in the following circumstances only:

- Where academic work has been hampered to a substantial degree by illness or other cause;
- The circumstances are unexpected and beyond the student's control;
- The circumstances could not have reasonably been anticipated, avoided or guarded against by the student; and either:
 - (i) they occurred during a critical study period and was 3 consecutive days or more

duration, or a total of 5 days within the critical study period; or

(ii) they prevented the ability to complete, attend or submit an assessment task for a specific date (e.g. final exam, in class test/quiz, in class presentation)

Applications for Special Consideration must be made as soon as practicable after the problem occurs and at the latest within three working days of the assessment or the period covered by the supporting documentation.

By sitting or submitting the assessment task the student is declaring that they are fit to do so and cannot later apply for Special Consideration (UNSW 'fit to sit or submit' requirement).

Sitting, accessing or submitting an assessment task on the scheduled assessment date, after applying for special consideration, renders the special consideration application void.

Find more information about special consideration at: <https://www.student.unsw.edu.au/special/consideration/guide>

Or apply for special consideration through your [MyUNSW portal](#).

Late Submission of assessment tasks (other than examinations)

UNSW has a standard late submission penalty of:

- 5% per day,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Electronic submission of assessment

Except where the nature of an assessment task precludes its electronic submission, all assessments must be submitted to an electronic repository, approved by UNSW or the Faculty, for archiving and subsequent marking and analysis.

Release of final mark

All marks obtained for assessment items during the session are provisional. The final mark as

published by the university following the assessment review group meeting is the only official mark.