1. **Title of the module**

CHEM5320 (CH532) - Spectroscopy and Bonding

1. **School or partner institution which will be responsible for management of the module**

Physical Sciences

1. **The level of the module (Level 4, Level 5, Level 6 or Level 7)**

Level 5

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Autumn and Spring

1. **Prerequisite and co-requisite modules**

Prerequisites:

CHEM3080 Molecules Matter & Energy

CHEM3200 Chemical Reactions

CHEM3820 Chemical Skills

1. **The programmes of study to which the module contributes**

MChem/BSc Chemistry (Stage 2)

This is not available as a wild module.

1. **The intended subject specific learning outcomes.
On successfully completing the module students will be able to:**

Have the knowledge and critical understanding of:

* 1. Basic quantum mechanical concepts
	2. Basic concepts of molecular symmetry and group theory.
	3. How to obtain and interpret spectra to calculate molecular parameters from spectroscopic data.

Intellectual skills:

* 8.4 Link quantum mechanical theories to experimental observables.
* 8.5 Interpret spectroscopic data.
* 8.6 Perform practical experiments to gain spectroscopic information.
* 8.7 Operate standard chemical instrumentation, record data and evaluate observations and errors.

Subject-specific skills:

* 8.8 Demonstrate knowledge of basic spectroscopy; microwave, infrared, UV-VIS, Raman.
* 8.9 Perform calculations on molecular parameters from spectroscopic data.
* 8.10 Understand quantum mechanical concepts underlying bonding and energy transitions experimentally observed in spectroscopy.
* 8.11 Understand symmetry of molecules to determine spectroscopic data.
* 8.12 Make use of appropriate texts, or other learning resources as part of managing their own learning.
1. **The intended generic learning outcomes.
On successfully completing the module students will be able to:**

Have a knowledge and understanding of:

* 9.1 Problem-solving skills, an ability to formulate problems in precise terms and to identify key issues, and the confidence to try different approaches in order to make progress on challenging problems.
* 9.2 Analytical skills – associated with the need to pay attention to detail and to develop an ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly.
* 9.3 Personal skills – the ability to work independently, to use initiative, to organise oneself to meet deadlines and to interact constructively with other people.
1. **A synopsis of the curriculum**

This module will deepen your understanding of the fascinating world of quantum mechanics and symmetry. We explore how this gives rise to quantisation and selection rules, and go on to apply this to spectroscopic methods to understand structure and bonding including: rotational (microwave) spectroscopy, vibrational (IR and Raman) spectroscopy and electronic transitions (UV-vis). The lab course will give you hands on experience of some of these quite abstract concepts, and will allow you to apply your spectroscopic skills to real chemical problems. (Lab component.)

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**
* P.W Atkins, Physical Chemistry (2014)
* C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy (1994)
* Y. Jean, F. Volatron and J. Burdett, An Introduction to Molecular Orbitals (1993)
1. **Learning and teaching methods**

Total contact hours: 56

Private study hours: 94

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods

Assessment 1, problem solving (5%), 120 minutes

Assessment 2, problem solving (5%), 120 minutes

Problem Sheet 1 (30 mins, 0.833%)

Problem Sheet 2 (30 mins, 0.833%)

Problem Sheet 3 (30 mins, 0.833%)

Problem Sheet 4 (30 mins, 0.833%)

Problem Sheet 5 (30 mins, 0.833%)

Problem Sheet 6 (30 mins, 0.833%)

Practicals (16 pages, 25%)

 Examination (60%)

13.2 Reassessment methods

Like-for-like

1. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section12) and methods of assessment (section 13)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | *8.1* | *8.2* | *8.3* | *8.4* | *8.5* | *8.6* | *8.7* | *8.8* | *8.9* | *8.10* | *8.11* | *8.12* | *9.1* | *9.2* | *9.3* |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Private Study** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| Lecture | **x** | **x** |  | **x** | **x** |  |  | **x** | **x** | **x** | **x** |  | **x** | **x** |  |
| Laboratory |  |  | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| Workshops | **x** | **x** |  | **x** | **x** |  |  | **x** |  | **x** | **x** | **x** | **x** | **x** | **x** |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Practicals |  |  | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| Assignments | **x** | **x** | **x** | **x** | **x** |  |  | **x** | **x** | **x** | **x** | **x** | **x** | **x** |  |
| Examination | **x** | **x** |  | **x** | **x** |  |  | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered**

Canterbury

1. **Internationalisation**

Chemistry is an international subject with physical laws discovered and techniques developed and refined by scientists across the globe. Mastery of the subject-specific learning outcomes, will equip students to apply the theories and techniques of this module in a wide range of international contexts. The module team is drawn from the School of Physical Sciences, which includes many members of staff with international experience of teaching and research collaboration. In compiling the reading list, consideration has been given to the range of texts that are available internationally and a selection of texts has been identified to complement the delivery of the material. The support SPS provides to its students is also internationally attuned given our international student body.*.*

**FACULTIES SUPPORT OFFICE USE ONLY**

**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
| 10/07/2019 | Minor | September 2019 | 13, 14 |  |
|  |  |  |  |  |