Ollscoil na Gaillimhe
University of Galway

Year 4 Biopharmaceutical Chemistry

Information Booklet

2023-2024

School of Biological & Chemical Sciences

Contents

Course Summary

Code	Sem	Name	Credit	Exam/Assess*
CH4116	I	BPC Dissertation	20	CA / Pres
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* CA = continuous assessment, Pres = presentation plus Q&A, Exam = 2 hour examination.

Module Workload

5 Credit (ECTS) Module 100-125 h

The time spent on a 5 credit module includes the teaching contact with staff and autonomous learning. Autonomous learning includes time spent working independently carrying out assignments, additional reading, learning and revising. Normally autonomous study is 3-4 times that of the contact time spent with staff. For example, a taught module may include ~25 hours of teaching and ~100 hours of study.

Continuous assessment

Continuous assessment (CA) is usually in the form of in-class tests during the teaching semester that will be graded. It may also involve preparing a presentation, a report or other types of assignment. In modules with exams the continuous assessment will contribute 20 % of the module mark.

Important Dates

Completion Date	Activity	Responsible
May – July 2023	**Work placement commences** Complete tripartite agreement and job specification	Student
July 2023	**Assign dissertations**	Module coordinator
August – October 2023	**Interim placement meeting**	Student to organize meetings with industrial and academic supervisors
03 October 2023	**Dissertation Stage 1** Submit outline and introduction to supervisor	Student
28 November 2023	**Dissertation Stage 2** Submit draft dissertation to supervisor	Student
11 December 2023	**Work placement presentation**	Student and academic staff
11 December 2023	**Work placement reference** Submitted by email to Karen Kelly	Student and industrial supervisor
14 December 2023	**Work placement report** Submit *via* Canvas by 15.00	Student
13 December 2023	**Dissertation presentation** Presentation and oral exam	Student and academic staff
15 December 2023	**Final Dissertation** Submit *via* Canvas by 15.00	Student

Induction

Safety

Students on placement will be expected to undergo local safety induction within their placement location. The time and nature of any safety induction should be recorded and included in the report on the placement.

Regardless of where the placement or project is undertaken all students are expected to work safely, risk assess their work before starting on it and consult with their supervisors on the safety aspects of their work particularly before starting a process for the first time or if they are uncomfortable with any safety issue in their workplace. Safe working requires active participation on all workers part, passive participation is not enough.

Electronic Literature & Databases as sources of information

The students will be instructed in the use of online electronic resources to search for chemical and research information. Students will be expected to be able to retrieve information via searches on Web of knowledge, Reaxys, Scifinder Scholar, SDBS, NIST and chemical suppliers databases. Students will also be instructed in the use of reference management software (Endnote) and will be expected to be able to create, populate and maintain a database relevant to their dissertation thesis or project.

CH4116: BPC Dissertation

CH4116 is a **10 ECTS** module, representing one sixth of year 4. Ensure to give this module the necessary time and effort that it warrants.

A dissertation supervisor will be assigned and the student will agree on a suitable topic in discussion with their supervisor. The student will demonstrate awareness/understanding of the state-of-the-art in their assigned topic. That involves critically analysing the relevant literature and writing a report that is accessible to a general audience. Ideally, the student will use their independent investigation to challenge current teaching and provide new insights in chemistry.

CH4116 learning outcomes:

- To manage your own learning
- To apply the basic knowledge gained in your studies
- To consolidate your knowledge / understanding of chemistry
- To develop skills such as finding data in the literature
- To organise and summarise knowledge in a written report
- To present the outcomes of your investigations before a group of examiners
- To defend your dissertation and demonstrate understanding / knowledge of chemical concepts

CH4116 timeline and assessment:

Task	Deadline*	Task	Grade
Topic assigned	mid-July		
Dissertation plan	26 September 2023	Student discusses plan with supervisor	
3 page intro and outline	03 October 2023	Student submits by email to supervisor	10%
Draft dissertation	28 November 2023	Student meets supervisor for feedback	10%
Presentation / oral exam	13 December 2023	On campus presentation	20%
Final dissertation	15 December 2023		60%

*The deadline is when the task must be completed. You are encouraged to complete tasks in advance of the deadline.

Pointers for preparing your dissertation and presentation

1. Read book chapters and review papers relevant to your topic.
    - Imitate the structure/style to develop your own writing
    - Think about which sub-topics are essential, most relevant to your work
    - Avoid going into detail about aspects that are too basic

2. A picture paints a thousand words...
    - Figures are crucial to explaining concepts, guiding the reader
    - Make your own figures. Credit is not awarded for figures taken from other sources
    - Prepare figures that can be use in the dissertation as well as in the presentation

3. References
    - Cite primary literature, not just reviews
    - Do not cite websites (database urls can be cited)
    - Format references identically

4. Prepare professional / high quality documents
    - Include a proper title page, page numbers etc.
    - Proofread your work, no typos or poor formatting
    - Every figure should have a legend and be referred to in the main text

Detailed Guidelines
The thesis is normally 20-25 pages with a focus on quality. Prepare your dissertation in parallel with your work placement. You must use online library resources such as journals (not Wikipedia) to find facts/data relevant to the topic. Discuss the structure of your thesis with your supervisor and include the following sections:

1. Title of Dissertation

2. Abstract and Graphical Abstract
A concise summary (up to 350 words) of objectives, findings and conclusions. Include any highlights that emerged from your investigation. Include a graphical abstract.

3. Introduction
1-2 pages of background, explaining the reasons for undertaking the work and your objectives. References must be included and numbered in sequence as they occur in the text with a superscript.[1-3] The full reference is listed at the end of the report. References should be primary literature (not reviews). The final section of the introduction must provide a brief summary of the outcomes of the investigation. Structure diagrams or schemes can be drawn with ChemDraw. Compounds should be numbered in bold as they appear in schemes.

4. Results / Discussion
Students may include a brief methodology section where the approach to generating information is summarised. Students are advised to detail the findings of their investigative work under a series of relevant headings, which contains appropriate citation. The structure of this section should be discussed and planned with the supervisor. Include a discussion of any emerging themes or findings. Provide any relevant figures or schemes or tables that are needed to efficiently and clearly present your findings. Number figures etc in order of appearance in the text. Make your own figures, do not use copy&paste from the literature or websites.

5. Conclusions
Include a detailed conclusions section of 1-2 pages. Suggest future developments of the field.

6. References – Use the RSC style
1. T. J. Hebden, R. R. Schrock, M. K. Takase and P. Müller, *Chem. Commun.*, 2012, **48**, 1851–1853.
2. S. T. Beckett, *Science of Chocolate*, Royal Society of Chemistry, Cambridge, 2000.

Reference 1 is a paper and reference 2 is a book.

Plagiarism
You must write the thesis in your own words. Do not copy text from the literature or internet or use any third party supplier of dissertations. Students must prepare their own figures rather than copying from the literature or websites.

CH4117: Work Placement

This module is worth **20 ECTS**. Your @nuigalway.ie address is the one that we will use for bringing you updates, advice and reminders. Please ensure that you check your college e-mail regularly.

Learning Outcomes

1. Show an appreciation for the organization where you carried out your placement, its management structure and the environment in which it operates.

2. Increase your knowledge regarding your employability and insight into transferrable skills. Identify career choices in light of your work placement.

3. Demonstrate an appreciation of health & safety in the workplace.

4. Link the work placement to your programme of study.

5. Demonstrate effective **People Skills** such as negotiation, team working, leadership, interpersonal and communication skills.

6. Demonstrate effective **Self-reliance Skills** such as initiative, networking, willingness to learn, reliability, punctuality and prioritising tasks.

7. Demonstrate the required **Technical** and **General Skills** of the given work place.

8. Demonstrate **Independent Investigation** of a process that was important to your work. The process may be chemical, industrial, bureaucratic, regulatory affairs *etc.*

CH4117: Assessment and Reporting Requirements		
Task	**Description**	**Marks**
Interim Meeting	An academic staff will meet separately the student and the placement supervisor to review progress. Typically within first 3 months.	10
Oral Presentation	Presentations are held on campus at the placement end, typically mid-December.	20
Employer Evaluation	Your supervisor provides an appraisal at placement end. **The student must pass this evaluation.**	Pass/Fail
Final Report	The student submits their report (see guidelines) via Blackboard at the placement end.	70

Health and Safety Guidelines

- Primary responsibility for health and safety of a placement student lies with the placement provider under Safety, Health and Welfare at Work Act 2005 and regulations therein.

- The student is treated equivalent to an employee in relation to health and safety matters.

- The student has responsibilities to follow instructions and act sensibly to protect their own health and safety and that of others.

Work Placement Schedule		
Task	**Deadline**	**Responsible / Outcome**
1. Job specification	27 June 2023	Employer in cooperation with placement coordinator/placement office. Student includes copy of the specification with final report. School Placement Coordinator must approve job specification.
2. Tripartite agreement	27 June 2023	Student gets academic supervisor, employer to sign the document and provides a copy to the various parties and the School administrator. The student includes copy with final report.
3. Placement safety risk assessment	27 June 2023	Student provides to School Administrator/safety coordinator. Include in final report.
4. Interim meeting / evaluation	Completed before mid-September	Employer, university supervisor, student meet online or at workplace to discuss progress in attaining learning outcomes and review the placement log and activity. Induction of the student into the workplace is reviewed.
5. Employer evaluation	11 December 2023	Employer provides their evaluation of the student by email to karen.kelly@nuigalway.ie
6. Presentation on work placement	11 December 2023	Students, academic staff on campus.
7. Work placement report	13 December 2023	Marks will be deducted for late submission.
8. Feedback by student/employer regarding placement	15 December 2023	Students/employer give feedback to help improve placement process.

BPC Placement – Tripartite Agreement 2023

The student is responsible for completing this form as soon as possible and sending a signed copy to Prof Peter Crowley peter.crowley@nuigalway.ie and Karen Kelly karen.kelly@nuiugalway.ie

Employer and Supervisor Details	
Company name	
Address	
Supervisor name	
Department	
Supervisor phone	
Supervisor email	
Student Details	
Course Title	CH4117 Biopharmaceutical Chemistry, Work Placement
Name	
Phone	
Email	
Current address	

Academic Supervisor Details	
Name	
Department	School of Biological and Chemical Sciences, University of Galway
Email	

Signatures		
Employer		Date:
Student		Date:
University of Galway		Date:

Guidelines for Work Placement Report

Your report must address points 1-9.

Demonstrate your achievement of the learning outcomes.

1. **Job Specification:** Include the job description (see template, 1 page).

   [5 marks]

2. **Organisation:** Describe the organisation where your completed your placement. Describe the management structure, and the environment of daily operations (2 pages).

   [5 marks]

3. **Role of student:** Describe the role you played within the organisation. Provide details on who you worked with (e.g. their role) and your responsibilities (1 page).

   [5 marks]

4. **Technical and general skills:** List the required skills (under the headings, Technical Skills, People Skills, Self-reliance Skills) of the workplace. Describe how you acquired and developed these skills during your placement (2 pages).

   [10 marks]

5. **Future employability:** How has the work placement improved your employability? Discuss career possibilities that the work placement has opened up and that you will now consider (1 page).

   [5 marks]

6. **Relationship to programme of study:** Describe how the work placement was related to your Biopharmaceutical Chemistry programme of study (1 page).

   [5 marks]

7. **Independent Investigation:** Describe a process (chemical, industrial, bureaucratic, regulatory affairs *etc.*) which you worked on during your placement. Explain how the process works and demonstrate how you used your knowledge to aid implementation and/or development of the process (2 pages including 2 or more diagrams/figures that you prepared).

   [25 marks]

8. **Safety risk assessment:** Include your placement health & safety risk assessment. Provide details e.g. MSDS for hazardous materials (2 pages).

   [5 marks]

9. **CV:** Include your updated CV indicating relevant details of work placement (2 pages).

   [5 marks]

10. **Appendix:** Option to Include certificates of skills and achievements, and training completion documents acquired during the placement.

Job Specification

A job specification will be provided by the employer in collaboration with the placement office/placement coordinator. Students should keep a record of their job specification and include it in their final report.

Job Specification Template	
Work Location	
Job Title & Pay (€)	
Description of work undertaken by student	
Key skills / aptitudes required	
Main learning opportunities	
Days/hours of weekly attendance	
Line Manager (workplace mentor) title and name	

Workplace Learning Journal

The student is required to keep a journal, completed with the placement supervisor. This journal will be evaluated at the interim meeting and will be helpful in preparing the final report.

Student Name:

Company Name:

Job Title:

Week	**Task/Activity**	**Skills required/acquired**	**Supervisor Initials**

Linking Learning to Outcomes

Learning event	What did you learn?	Relevant outcome	Evidence

Add more lines as required

Academic Supervisor – Interim Placement Meeting Report

Student and placement supervisor should confirm student has satisfactorily completed induction and required training and developed the required competences.

Name of student:

Date of visit and location:

	Yes/No	Comment
Induction and training		
Student workload journal up to date and complete		Students provides a sample of the workplace journal (see template) in advance of the meeting.
Comments:		

Work placement induction (/4 marks):

Workplace journal (/6 marks):

Total (/10 marks):

Name:

Signature:

Date:

Placement Supervisor – Appraisal Form

To be completed by the **supervisor** at placement end

Organisation Name & Location	
Student Name	
Job title	
Start date	
End date	

Please provide a frank assessment of the student you supervised on placement.
Did the student work effectively / efficiently?
Did they demonstrate relevant knowledge / competency / initiative / willingness to work?
Did they learn / develop throughout the placement?
Did they work well with others and communicate well?
Did they work professionally and exhibit planning / timekeeping / organisation?

Grade: Pass / Fail

Would you take another University of Galway placement student? Yes/No

Supervisor name:

Date:

CH4113: Organic Chemistry

Staff: Dr Eddie Myers (coordinator), Prof. Paul Murphy

1. Pericyclic and Radical Reactions (12 h)
2. Selectivity in Organic Synthesis (12 h)

1. Pericyclic and Radical Reactions (12 h)

Students will be assessed on the following learning outcomes:

- The ability to classify a pericyclic reaction as either a cycloaddition, an electrocyclic reaction, a sigmatropic rearrangement or a group-transfer reaction.
- The ability to predict the sense of a pericyclic reaction (suprafacial/antarafacial and disrotatory/conrotatory) under a certain set of reaction conditions (thermal/photochemical) based on the Woodward–Hoffman Rules.
- The ability to draw a set of π-based molecular orbitals for any conjugated molecule, to assign electrons to these orbitals, to identify the HOMO and LUMO orbitals and to use the resulting information to predict the sense of a pericyclic reaction under thermal or photochemical conditions.
- To understand the concept of stereospecificity pertaining to pericyclic reactions and to be able to predict the diastereoselectivity of a pericyclic reaction.
- The ability to use structural features to predict the relative rate and regioselectivity of pericyclic reactions.
- The ability to draw radical reaction mechanisms by using single-headed (fishhook) arrows.
- To understand and distinguish radical stability and reactivity.
- To understand the major types of reactions and processes involving radicals, such as fragmentation of weak bonds to form radicals, atom abstraction reactions, the addition of radicals to alkenes, and radical-radical combination and disproportionation.
- To understand radical chain processes and their use in the formation of rings and polymers
- To understand electron paramagnetic resonance as an analytical method for the study of radicals
- To have an appreciation for the role of radical reactions in biology and chemical biology.

2. Selectivity in Organic Chemistry (12 h)
The learning outcomes that will be assessed will include evaluation of student's knowledge and understanding of important reactions in organic synthesis and factors which influence those such as for those mentioned below:

- Chemoselective reactions of carbonyl compounds with various reducing reagents.
- Chemoselective reactions of alcohols and alkenes with oxidising agents
- Stereoselective olefination (alkene forming reactions)
- Enantioselective oxidation and reduction
- Stereoselective substitution reactions (basis in SN1, SN2 reactions)
- Regioselective reactions with carbohydrates/cyclic epoxides
- Bioorthogonal reactions

CH4115: Biopharmaceutical Chemistry

Tutors: Prof. Peter Crowley (coordinator) and Prof. Paul Murphy.

Sections

1. Carbohydrate Chemistry in Biopharmaceutical Science – Prof Murphy
2. Biopharmaceuticals – Prof Crowley

1. Carbohydrate Chemistry in Biopharmaceutical Science (12 h)

Learning outcomes:

- Draw and understand the structures of saccharides, oligosaccharides, glycopeptides, glycolipids.
- Demonstrate knowledge and understanding of the chemistry involved in (bio)synthesis of glycoconjugates including glycoproteins.
- Demonstrate knowledge and understanding of the roles of carbohydrates in biological systems and in biopharmaceuticals, including their molecular recognition properties.
- Describe and understand methods for analysis of oligosaccharides, glycopeptides & glycoproteins and understand why this is important to biopharmaceuticals (NMR, chemical analysis, Mass Spectrometry).
- Describe the chemistry (chemoenzymatic synthesis) used to prepare peptides and glycopeptides

2. Biopharmaceuticals (12 h)

Learning outcomes:

- Insulin structure, function and delivery. Engineered / modified insulins with fast and slow action.

- Antibody structure and how this relates to binding and therapeutic function. Conventional heavy and light chain antibodies versus single chain antibodies (from camel and shark). Interface size, shape and chemical complementarity contributes to binding affinity.

- Protein-based therapeutics and circulation time. Half-life extension technologies and therapeutic delivery, PEGylation, PASylation. The chemistry of PEG.

- Asparaginase as a therapeutic. Biochemical basis of therapy. Type of asparaginase and activity profile.

CH432: Physical Chemistry II

Staff: Dr David Cheung (coordinator), Dr Mihai Lomora

1. Molecular Driving Forces
2. Analysis of Biomaterials

1. Molecular Driving Forces (12 hours, DC)

This block of lectures will explore how the behaviour of chemical and biological systems can be understood from simple physical principles. It will cover the following topics:

- Entropy and free energy
- Interfaces, wetting, and capillarity
- Phase transitions and phase separation
- Co-operativity
- Adsorption, binding, and catalysis

2. Analysis of Biomaterials (12 hours, ML)

The course outline and learning outcomes that will be assessed from this topic will comprise:

- General overview of biomaterials: main types (polymers, metal/metal oxides, ceramics, composites) and specific characteristics, key bulk & surface properties

- State-of-the-art characterization techniques generally used for the physical and chemical analysis of biomaterials. The general operation principles, sample preparation, and instrumental technical details accompanied by real-world examples of analysed biomaterials will be covered for the following techniques:
  Stopped Flow Spectroscopy, ***Electronic and Vibrational Circular Dichroism*** *(eCD, vCD),* ***Polarimetry***, ***Ramachandran plots***, ***Fluorescence Microscopy, Confocal Microscopy, Fluorescence Lifetime / Imaging:*** *Fluorescence Correlation Spectroscopy (FCS), Fluorescence Cross-correlation Spectroscopy (FCCS), Fluorescence Lifetime Correlation Spectroscopy (FLCS), Fluorescence Lifetime Imaging Microscopy (FLIM), Förster Resonance Energy Transfer (FRET),* ***Super Resolution Microscopy:*** *Stimulated Emission Depletion Microscopy (STED),* ***Electron Microscopy:*** *Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Environmental SEM (ESEM),* ***Scanning Probe Microscopy (SPM):*** *Scanning transmission microscopy (STM), Atomic Force Microscopy (AFM),* ***Contact Angle, Dynamic / Static Light Scattering*** *(DLS, SLS), and* ***Nanoparticle Tracking Analysis*** *(NTA)*

CH438: Bioorganic Chemistry

Tutors: Prof. Peter Crowley and Dr. Binh Mai.

Sections:

1. Supramolecular Protein Chemistry – Prof Crowley
2. Stimuli-responsive Polymers – Dr Binh Mai

1. Supramolecular Protein Chemistry (12 h)

Learning outcomes:

- Protein interactions and molecular recognition
- Macrocycles, calixarenes, cucurbiturils, cyclodextrins
- Supramolecular ligands for protein recognition and assembly
- The chemistry of the cationic residues Arg and Lys
- Methods to study protein interactions (*e.g.* X-ray, NMR, ITC)

2. Stimuli-responsive Polymers (12 h)

Learning outcomes:

- Fundamental definitions in polymer science
- Characterization of polymers (e.g. NMR, FT-IR, SEC, MALDI-TOF) and polymer nanoparticles (e.g. DLS, Electron Microscope)
- Polymerization techniques (coordination, ionic, radical polymerization)
- Advanced polymer chemistry (Living Radical Polymerization)
- Thermo-responsive polymer and the principles to design stimuli-responsive polymer

CH445: Advanced Inorganic Chemistry

Staff: Dr Pau Farras (coordinator), Dr Constantina Papatriantafyllopoulou

1. Energy and respiration in biological systems (Dr Pau Farras)
2. Molecular Magnetism (Dr Constantina Papatriantafyllopoulou)
3. Porous Materials (Dr Constantina Papatriantafyllopoulou)

This module will look over contemporary chemistry, with examples of inorganic chemistry which aim to solve some of the current societal challenges. The content of this module has direct relationship with the Sustainable Development Goals (SDG):
SDG2: No Hunger SDG6: Clean Water and Sanitation SDG7: Affordable and Clean energy
SDG11: Sustainable Cities and Communities SDG13: Climate Action

1. Energy and respiration in biological systems (11 lectures + 2 tutorials, PF)
The students will be introduced to the synergy between natural and artificial systems for the design of novel metal-based devices to tackle the issues related to renewable energies. The learning outcomes that will be assessed will include:

- Correlation between basic electron transfer theories with real biological systems such as proteins.
- Photosynthesis and mechanisms of energy transfer.
- Oxygen metabolism and fuel cells.
- Nitrogen fixation and the future of fertilisers.

2. Molecular Magnetism (6 lectures + 1 tutorial, CP)
The learning outcomes that will be assessed are:

- The student being able to understand basic concepts and definitions in molecular magnetism (magnetization, magnetic susceptibility, spin), and recognize the different types of magnetic behaviour.
- The student being able to predict all the possible spin states for a metal compound.
- The student being able to describe and understand the mechanisms of magnetic interactions.
- The student being able to understand the single molecule magnetism behaviour and its potential use in technological applications (information storage devices, quantum computing).

3. Porous Materials (6 lectures + 1 tutorial, CP)
This lecture series will deal with the synthesis, properties and applications of porous materials. Specifically, the following topics will be covered:

- classification of porous materials;
- general features of main categories of porous materials, including zeolites, activated carbon, carbon nanotubes, mesoporous silica, mesoporous alumina, etc;
- metal-organic frameworks: synthesis, properties and applications (drug delivery, gas storage/separation, catalysis, sensing, etc)

Continuous assessment The continuous assessment will be in the form of in-class tests during the teaching semester that will be graded. There will be tests in the week of February 6th and in the week of March 13th. The continuous assessment will contribute 20 % of the overall grade for the module. In addition, for part 1 Energy and Respiration, group presentations will be done on the week of March 6th and will account for 5% of the overall grade for the module.

CH446: Bioinorganic and Inorganic Medicinal Chemistry

Staff: Dr Andrea Erxleben (coordinator), Dr Stanislas Von Euw

Topics

1. Metals in Medicine (Dr Andrea Erxleben)
2. Biomineralisation (Dr Stanislas Von Euw)

1. Metals in Medicine [12 lectures + 2 tutorials]

The learning outcomes that will be assessed will include:

- The student being able to describe the relevance of various metals in medicine. Metals covered will include: Pt, Ru, Ga, Au, Gd and various radioactive metals (e.g. Tc).
- The student being able to describe and understand the chemistry of antitumour active platinum compounds with regard to the synthesis of cis- and transplatin, coordination chemistry of Pt, trans-effect, mechanism and kinetics of ligand substitution, solution behaviour of cisplatin, reaction of cisplatin with DNA, nucleobases and amino acids, structure-activity relationships for Pt drugs, Pt NMR.
- The student being able to understand and explain aspects of the coordination chemistry of Ru, Ga, and Au relevant to the biological behaviour of these metals
- The student being able to understand and explain the function of photosensitizers in photodynamic tumour therapy.
- The student being able to understand and explain the study of covalent and non-covalent interactions between metal complexes and DNA.
- The student being able to understand and describe the generation and selection criteria of therapeutic and diagnostic radionuclides, the synthesis of radiopharmaceuticals and the function of radiosensitizers.
- The student being able to understand and explain the choice of metals and ligands suitable for MRI contrast agents.

2. Biomineralisation [12 lectures + 2 tutorials]

The students will be introduced to the mechanisms of biomineralization. A particular emphasis will be given to calcified tissues (bone, mollusc shells) since their hierarchically-organized structures provide design principles for the fabrication of advanced materials.

The learning outcomes that will be assessed will include:

- The student being familiar with the concepts of biomineralization.
- The student being familiar with a number of materials characterization techniques used to investigate the growth of inorganic crystals in synthetic and biological systems.
- The student being able to describe and identify the different pathways to crystallization associated with non-classical crystal growth.
- The student being able to explain the different bio-inspired mineralization processes.

Semester II Timetable

Week Beginning	08-Jan	15-Jan	22-Jan	29-Jan	05-Feb	12-Feb	19-Feb	26-Feb	04-Mar	11-Mar	18-Mar	25-Mar	01-Apr Easter	08-Apr/12 Apr Study Week	15-Apr/1May Exams
Bioinorganic and Inorganic Medicinal Chemistry - CH446															
Week	1	2	3	4	5	6	7	8	9	10	11	12			
Mon 9-10 AC202	Metals in Medicine				Holiday	Biomineralization					Holiday	Tutorial (SVE)			
Mon 10-11 AC202					Holiday						Holiday				
Wed 12-1 AC214	Dr Andrea Erxleben				Test	Dr Stan von Euw					Tutorial (AE)				
Physical Chemistry - CH432															
Week	1	2	3	4	5	6	7	8	9	10	11	12			
Tues 1-2 Dillon	Molecular Driving Forces				Test	Analysis of Biomaterials				Test					
Thu 9-10 AC204															
Thu 10-11 AC204	Dr David Cheung					Dr Mihai Lomora									
Bioorganic Chemistry - CH438															
Week	1	2	3	4	5	6	7	8	9	10	11	12			
Tue 9-10 AC202	Supramolecular Protein Chemistry					Stimuli-responsive Polymers									
Tue 10-11 AC202															
Wed 2-3 Dillon	Prof Peter Crowley				Test	Dr Binh Mai				Test					
Organic Chemistry - CH4113															
Week	1	2	3	4	5	6	7	8	9	10	11	12			
Tue 12-1 Dillon	Pericyclic and Radical Reactions					Selectivity in Organic Synthesis				Test	EM	PM			
Fri 1-2 AC203					Test						EM	PM			
Fri 2-3 AC203	Dr Eddie Myers					Prof. Paul Murphy					EM	PM			
Advanced Inorganic Chemistry - CH445															
Week	1	2	3	4	5	6	7	8	9	10	11	12			
Thurs 2-3 D'Arcy	Molecular Magnetism & Porous Materials				Test	Energy and Respiration in Biological Systems				Test	CP	PF			
Fri 10-11 AC202											CP	PF			
Fri 11-12 AC202	Dr Constantina Papatriantafyllopoulou					Dr Pau Farras					CP	PF			
Biopharmaceutical Chemistry - CH4115															
Week	1	2	3	4	5	6	7	8	9	10	11	12			
Mon 11-12 Room 231	Glyco Biopharma				Holiday	Protein Therapeutics					Holiday				
Mon 12-1 Room 231					Holiday						Holiday				
Wed 1-2 Dillon	Prof Paul Murphy				Test	Prof Peter Crowley				Test					

Study week

Exams