Accessibility statement

UNIVERSITY of York

Synthesis - From Nature to the Lab - CHE00034M

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- **Department**: Chemistry
- **Module co-ordinator**: Prof. Peter O'Brien
- **Credit value**: 10 credits
- **Credit level**: M
- **Academic year of delivery**: 2020-21
  - See module specification for other years: 2019-20

Module will run

Occurrence	Teaching cycle
A	Spring Term 2020-21 to Summer Term 2020-21

Module aims

This module builds on knowledge of core organic chemistry by exploring advanced synthetic pathways. The module is useful preparation for those planning to spend their final year carrying out a synthetic placement in industry (e.g. in the pharmaceutical/agrochemical industry). First, the module will outline how biological systems achieve the synthesis of complex natural products through biosynthetic pathways. Next, advanced retrosynthesis will be covered, in particular Diels-Alder and umpolung reactions, together with aspects of stereoselective synthesis using organo-main group synthetic approaches. Finally, a range of approaches for the introduction of nitrogen into complex molecules will be discussed since nitrogen-containing functional groups are widespread in pharmaceutical and agrochemical compounds.

Module learning outcomes

- to devise biosynthetic routes to polyketides, terpenes and alkaloids
- to devise complex synthetic routes to target molecules using a range of new types of disconnections (e.g. Diels-Alder, umpolung).
- to understand a range of organo-main group reactions
- to understand the ways in which nitrogen can be introduced into molecules and apply these to unseen problems.

Module content

Introduction to Advanced Organic Synthesis (PAOB and PAC 1 h w/shop)

This introductory workshop will cover some of the key synthesis and retrosynthesis parts of previous core modules. It will also provide a forward look into the strategy and planning of synthesis of complex molecules.

Biosynthesis of Polyketides, Terpenes and Alkaloids (AR 4 lectures 1 h w/shop (AR/AFP) 2 h assess. w/shop)

This course will provide an introduction to biosynthetic pathways and reactions. Specific examples of biosynthesis will focus on those types of targets covered in the rest of this module and will include: polyketides; terpenes and alkaloids. An introduction to biomimetic synthesis is also presented.

Advanced Retrosynthesis (AFP 2 x 2 h flipped teaching w/shops 1.5 h w/shop (AFP/PAOB))

This course will be delivered in an innovative flipped style, in which audio/video recordings will be used and your understanding will be reinforced with highly interactive sessions. The course will explore guidelines for developing modern synthetic strategies, including formation of cyclic compounds using Diels-Alder reactions (asymmetric, intramolecular and polymer-supported reactions) and approaches using umpolung (reverse polarity) reactions. The strategies will be illustrated with the synthesis of biologically important target molecules.

Stereocontrolled Synthesis using Organo-Main Group Chemistry (PAC 4 lectures 1.5 h w/shop (PAC/AFP))

The course will examine methods for the stereocontrolled synthesis of key functionality found in natural products using reagents that contain sulfur, silicon and boron. Examples will include stereocontrolled formation of alkenes and vicinal (1,2) stereocentres.

Synthesis of Nitrogen-containing Pharmaceuticals and Natural Products (PAOB 4 lectures 1.5 h w/shop (PAOB/AFP))

This course will cover the synthetic strategies used to introduce nitrogen into molecules, including: amide formation; reductive amination; amination of alkyl and aryl halides; Pd- and Cu-catalysed amination of aryl halides; functionalisation of cyclic amines; synthesis of heteroaromatics (*e.g.* indoles).

Overview and Exam Preparation Workshop (PAOB/AFP 1 h w/shop).

Sample problems on the different courses will be set and answered in a workshop setting.

Assessment

Task	Length	% of module mark
24 hour open exam Synthesis - From Nature to the Lab	N/A	70
Practical Assessed Workshop	N/A	30

Special assessment rules

None

Additional assessment information

The 30% continuous assessment will cover AR's lecture course (Biosynthesis of Polyketides, Terpenes and Alkaloids) only.

The 70% closed exam will cover AFP, PAC and PAOB's lecture courses. The exam will contain two 20-mark compulsory questions covering AFP, PAC and PAOB's lecture courses.

Reassessment

Task	Length	% of module mark
24 hour open exam Synthesis - From Nature to the Lab	N/A	70
Practical Assessed Workshop	N/A	30

Module feedback

Closed exam results with per-question breakdown are returned to the students via supervisors within 5 weeks (as per special approval by the University Teaching Committee). Outline answers are made available via the Chemistry web pages when the students receive their marks, so that they can assess their own detailed progress/achievement. The examiners' reports for each question are made available to the students via the Chemistry web pages.

The continuous assessment assignment is marked within 4 weeks and the marks returned to students. General feedback is provided via the VLE on typical errors encountered in the assignment.

Indicative reading

The most useful textbook is Organic Chemistry, 2nd edition (Oxford) by Clayden, Greeves and Warren

Additional reading lists will be provided by the module tutors.