Module Specification

Module Title	Organic Synthesis	Module Code	CHE302u

Credit Value	15	Level	6	Mode of Delivery	On Campus	Semester A

Pre-requisite modules	Co-requisite modules	Overlapping modules
CHE202A and B Structure and Reactivity of Organic Chemistry		

1) Content Description

Provide a description of the module, as it will appear in the Module Directory and on the Student Information System (approx. 70-80 words).

The module aims to provide a wide understanding of the occurrence, synthesis and behaviour of organic compounds. Topics to be covered include: theory and application of retrosynthetic analysis, modern heteroatom chemistry, reactive intermediates & aromatic chemistry. The use of spectroscopic techniques as a tool for structure determination in organic chemistry will be embedded within the course. The module builds upon the knowledge of structure and reactivity of organic molecules gained in CHE202.

2) Module Aims

Specify the aims of the module, i.e. the broad educational purposes for offering this module.

This module covers the techniques used to plan the syntheses of organic compounds, together with a selection of reaction types that may be used in organic synthesis. The aim is to provide the student with sufficient knowledge and experience to analyse and evaluate the design of viable syntheses of simple natural products and drugs. These concepts along with modules previously studied provide a broad and balanced appreciation of key aspects of organic synthesis. Students should be able to answer the BSc threshold questions on organic chemistry as defined by the Royal Society of Chemistry by the end of this module.

3) Learning Outcomes

Identify the learning outcomes for this module, i.e. knowledge, skills and attributes to be developed through completion of this module. Outcomes should be referenced to the relevant QAA benchmark statements and the Framework for Higher Education Qualifications in England, Wales and Northern Ireland (2008). The SEEC Credit Level Descriptors for Further and Higher Education 2003 and Queen Mary Statement of Graduate Attributes should also be used as a guiding framework for curriculum design.

Academic Content:	
A1	Retrosynthetic analysis • Understand what is meant by retrosynthetic analysis and its standard terminology; • Draw and annotate retrosynthetic analyses, including all relevant information, such that it may be clearly understood by a third party; • Describe and apply the various techniques employed in such analysis to appropriate problems; • Evaluate conflicting reactivity in synthetic pathways, and construct strategies for circumventing such complexities.
A2	Modern heteroatom chemistry • demonstrate familiarity with recent applications of phosphorus, sulfur, boron, silicon, tin and selenium-mediated organic chemistry.

A 3	Reactive intermediates • Develop an understanding of key reactive intermediates such as carbenes, nitrenes, oxenoids, carbocations, cyclobutadienes, quinone methides. • Recognise how these can be harnessed in a synthetically useful manner for the construction of organic molecules
A 4	Aromatic chemistry • deepen understanding of the key concepts of aromaticity, and build upon concepts of electrophilic and nucleophilic substitution for the synthesis of polyfunctionalised rings; • comprehend the bonding and reactivity of para- and ortho-benzynes; • elaborate on the functionalisation of aromatic systems via organometallic reagents, catalysis and oxidation/reduction.

Disciplinary skills - able to:	
B1	Analyse a small natural product or drug, including those that contain polyfunctionalised aromatic rings, and provide a retrosynthetic analysis
B2	Design an appropriate forwards synthetic plan and suggest a viable reaction sequence that utilises modern heteroatom chemistry to minimise the length and potential cost of the route.
B3	Suggest reagents and conditions for the reaction sequence identified with due diligence to the competing reactivity of any organometallic or reactive intermediate employed
B4	Use curved arrow notation to write reasonable mechanisms for all of the reaction types discussed in the module.
B5	Explain control factors relating to geometry of alkenes or relative stereochemistry in the route suggested.

Attributes:	
C1	Acquire and apply knowledge relating to the principles and practices of organic chemistry
C2	Produce analyses which are grounded in experimental evidence (e.g. spectroscopic data)
C3	Apply existing knowledge and skills to investigate unfamiliar problems.

4) Reading List

Provide an indicative reading list for the module. This should include key texts and/or journals but should not be an exhaustive list of materials.

Organic Chemistry, J Clayden, N Greeves, S Warren and P Wothers, OUP

Organic Synthesis: The Disconnection Approach, S. Warren and P. Wyatt, Wiley

Workbook for Organic Synthesis: The Disconnection Approach, S. Warren and P. Wyatt, Wiley

The Logic of Chemical Synthesis. E. J Correy and X-M Cheng, Wiley

Reactive Intermediates, C J Moody and G.H. Whitham, OUP

Organic Synthesis: The Roles of Boron and Sillicon, S E Thomas, OUP

Organosulfur Chemistry, G H Whitham, OUP

Aromatic Chemistry, M Sainsbury, OUP

5) Teaching and Learning Profile

Provide details of the method of delivery (lectures, seminars, fieldwork, practical classes, etc.) used to enable the achievement of learning outcomes and an indicative number of hours for each activity to give an overall picture of the workload a student taking the module would be expected to undertake. This information will form the Key Information Set for each undergraduate programme and will be used to populate the KIS widget found

on the QMUL programme information pages. More information can be found online about KIS. You may also wish to refer to the QAA guidance on contact hours when completing this section.

Activity Type	KIS Category	Time Spent (in hours)
Lecture	Scheduled	22
Practical Classes and Workshops	Scheduled	8
Guided Independent Study	Independent	120
	Total	150

Specify the total module notional study hours. This should be a total of the hours given for each activity. The notional study hours for each academic credit point is 10. A 15 credit point module therefore represents 150 notional study hours.

Activity Type	Total Time Spent (in hours)	Percentage of Time Spent
Scheduled learning and teaching	30	20
Placement	0	0
Independent Study	120	80
Total	150	100

Use the information provided in the box above to specify the total time spent and the percentage time spent in each category of teaching and learning activity.

6) Assessment Profile

Provide details of the assessment methods used to assess the achievement of learning outcomes.

Description of Assessment	Assessment Type	KIS Category	Duration/Length	Percentage Weighting	Final element of assessment	Qualifying Mark
Coursework	Written Assignment, inc Essay	Coursework		10%	No	
Examination	Written Exam	Written	2.5 Hours	90%	Yes	

Final element of assessment: The assessment that takes place last. There should normally be only one element of assessment marked as final unless two assessment or submission dates occur on the same day.
Qualifying mark: A specified minimum mark that must be obtained in one or more elements of assessment in order to pass a module. This is in addition to, and distinct from, the requirement to achieve a pass in the module mark to pass the module.

Reassessment

Provide details of the reassessment methods used, specifying whether reassessment is either standard reassessment or synoptic reassessment.

○ Standard Reassessment ◉ Synoptic Reassessment

Synoptic reassessment details (if you have indicated synoptic reassessment above, please give details)		
Brief Description of Assessment	Assessment Type	Duration/Length of Examination/ Coursework
Resit Examination	Written Exam	2.5 Hours