School of Chemistry

Aims and Objectives: Session 2022-2023

Module CH5611: Asymmetric Synthesis

Duration: 20 hours

Lecturers: Dr C. P. Johnston and Professor A. D. Smith*

(*Module Convenor)

Aims: To survey briefly the specification of absolute and relative configuration and the measurement of the selectivity of stereoselective reactions. To cover some of the major stoichiometric and catalytic methods available for asymmetric synthesis. To consider the strategy behind synthetic design and particularly the retrosynthetic analysis approach. To understand the application of asymmetric synthetic methods, in addition to the arsenal of other organic chemical reactions studied to date, in the total syntheses of important and complex chiral compounds.

Objectives:

1. Understand the biological significance of chirality and the need for asymmetric synthesis. Know the meaning of enantiomers and e.e., diastereomers and d.e. Understand the systems used for the specification of absolute configuration of one or more stereogenic elements, and for the naming of pro-chiral faces. Know how to apply the Felkin-Anh model to predict which face nucleophilic attack will occur on an enantiotopic carbonyl group.

2. Understand the general strategy of asymmetric synthesis and the classification into chiral substrate, auxiliary, reagent and catalyst controlled processes. Understand the importance of substrate controlled stereo-selective reactions in the synthesis of complex targets from either natural starting materials, or those readily available using asymmetric catalysis.

3. Be able to give a detailed account of the course and mechanism of illustrative examples of the following asymmetric reactions that utilise chiral auxiliaries: enolate alkylation (oxazolidinones, oxazolines and chiral hydrazones), asymmetric (Evans) Aldol reaction and cycloaddition.

4. Be able to give a detailed account of the course and mechanism of illustrated examples of reactions that utilise chiral boron reagents.

5. Be able to suggest the correct type of catalyst used for asymmetric hydrogenation of a selection of unsaturated compounds, and the mechanism and applications of these reactions. Be able to give a detailed account of the application and mechanism of catalysts that are used for: asymmetric epoxidation and epoxide ring opening, asymmetric dihydroxylation, asymmetric additions of zinc reagents to aldehydes. Be able to apply the knowledge of catalyst architecture to rationalise stereochemistry in an unseen context. Give a mechanism and understand the principle behind enamine catalysis, iminium ion catalysis and nucleophillic catalysis.

6. Be able to suggest suitable methods for total synthesis of moderately complex compounds containing various functional groups and elements of asymmetry.