1. **Title of the module**
   Techniques for Purification and Analysis – GSKCHEM5

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

3. **The level of the module (Level 4, Level 5, Level 6 or Level 7)**
   HE Level 4 / NQF Level 7

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

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

6. **Prerequisite and co-requisite modules**
   None

7. **The programmes of study to which the module contributes**
   This is a compulsory module for the Postgraduate Certificate in Professional Development

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

   8.1. Understand a range of methods available for the purification of synthesised compounds, for example, silica-based chromatography, ion exchange methods or aqueous work-up, reverse phase methods. Including the selection of the most appropriate technique(s) for a particular purification

   8.2. Understand the main techniques used for the routine analysis of synthetic compounds, i.e. Nuclear Magnetic Resonance (NMR) and Liquid Chromatography-Mass Spectrometry

   8.3. Understand the information that can be obtained from the interpretation of a standard proton NMR experiment, and the limitations of the experiment.

   8.4. Appreciate the influence of one or more chiral centres on the proton NMR spectrum of a compound. Understand the use of chiral shift reagents to estimate compound enantiomeric and/or diastereoisomeric purity/composition

   8.5. Understand the influence of the salt form of the compound being analysed on the resultant spectrum

   8.6. Appreciate the effects on the spectrum of molecular properties, such as restricted rotation

   8.7. Understand the application of the Karplus equation to the interpretation of the spectra of carbocyclic and related systems

   8.8. Appreciate the role of experiments utilising the nuclear Overhauser effect to assist in structure elucidation.

9. **The intended generic learning outcomes.**
   On successfully completing the module students will be able to:

   9.1. Demonstrate an awareness of the range of methods available for the purification of synthesised compounds, for example, silica-based chromatography, ion exchange methods or aqueous work-up, reverse phase methods (A4, A6, A7, B1b, B1c, B1d, B2i, B2j, Cn)
9.2. Demonstrate an awareness of the main techniques used for the routine analysis of synthetic compounds, i.e. Nuclear Magnetic Resonance (NMR) and Liquid Chromatography-Mass Spectrometry (A6, A7, B1d, B2i, B2j, Cn)

9.3. Demonstrate an understanding of the information that can be obtained from the interpretation of a standard proton NMR experiment, and the limitations of the experiment (A4, A6, A7, B1b, B1c, B1d, B2j, Cn)

9.4. Appreciate the influence of one or more chiral centres on the proton NMR spectrum of a compound (B1d, B2k, Cn)

9.5. Demonstrate the use of chiral shift reagents to estimate compound enantiomeric and/or diastereoisomeric purity/composition

9.6. Demonstrate the influence of the salt form of the compound being analysed on the resultant spectrum (B1d, B2k, Cn)

9.7. Appreciate the effects on the spectrum of molecular properties, such as restricted rotation (B1d, B2k, Cn)

9.8. Demonstrate the application of the Karplus equation to the interpretation of the spectra of carbocyclic and related systems (B1d, B2k, Cn)

9.9. Appreciate the role of experiments utilising the nuclear Overhauser effect to assist in structure elucidation (B1d, B2k, Cn)

9.10. Whilst the specific “teaching sessions” are extremely important and informative for the participant, the real “training” derives from the application of the theory to the situations encountered by the participants on a daily basis. (B1b, B1c, B1d, B1e, B1g, B1h, B2j, Cm, Cq, Cs, Ct)

10. A synopsis of the curriculum

The module provides a continuing framework of learning for new staff entering the company, primarily recent Chemistry graduates. However, it is also suitable for those who have more industrial experience, but who wish to refresh and build on their knowledge and appreciation of synthetic chemistry. This group may include staff who initially joined the company without a first degree, but who have achieved an equivalent qualification by part time study.

11. Reading list (Indicative list, current at time of publication. Reading lists will be published annually)

- Lecture notes and tutorial questions are normally made available after each session. Further study of the subject is encouraged and this will improve the participant’s skills in efficient and effective literature retrieval and extraction of information.
- Purification methodology is referenced in “The Chemists’ Toolbox”, a GSK resource available in every research chemistry laboratory.
- Copies of reference material are also provided from the NMR course.

General


12. Learning and teaching methods

This module will be taught by means of an introductory lecture and a lecture on NMR techniques and problem solving. The lectures will be delivered by experienced GSK chemists experts.
Independent learning hours will include literature searching, private study, portfolio building and further learning gained “on the job”.

Learning hours: 50

13. **Assessment methods**

13.1 Main assessment methods

- Within an agreed timeframe (i.e. 6-12 months of starting work), participants should be confident in the use of a range of purification techniques; they should also be able to utilise the key analytical techniques (LC-MS and NMR) to ascertain the identity and purity of compounds. The assessment will be based on the judgement of their supervisor and supervisor’s line manager, with input from other colleagues as required, based on their daily use of the techniques in question.

- The participant will compile a body of experimental evidence demonstrating the application of relevant purification and analytical techniques which will be assessed by the supervisor and the supervisor’s line manager.

The participant’s supervisor will provide written justification regarding their assessment. The supervisor’s line manager will review, discuss with the supervisor, and ultimately ratify the recommendations of the participant’s supervisor.

The External Examiner will have access to:

- Examples where the knowledge acquired has been applied in the workplace, including:
  - Chromatograms, LC-MS traces and NMR spectra demonstrating that appropriate techniques have been used to achieve the relevant standard of purity
  - Laboratory notebook
- Worked tutorial problems (NMR tutorial)
- The supervisor’s and supervisor’s line manager’s assessment summaries

14. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section 12) and methods of assessment (section 13)**

<table>
<thead>
<tr>
<th>Module learning outcome</th>
<th>8.1-8.8</th>
<th>9.1-9.10</th>
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<tbody>
<tr>
<td>Learning/ teaching method</td>
<td>Hours allocated</td>
<td></td>
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<tr>
<td>Private Study/ “on the job”</td>
<td>44</td>
<td>X</td>
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<tr>
<td>Lectures</td>
<td>3</td>
<td>X</td>
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<tr>
<td>Tutorial</td>
<td>3</td>
<td>X</td>
</tr>
<tr>
<td>Assessment method</td>
<td></td>
<td></td>
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<tr>
<td>Report</td>
<td></td>
<td>X X</td>
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<tr>
<td>Solution to NMR tutorial problems</td>
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<td>X X</td>
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15. **Inclusive module design**

GSK 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

16. **Campus(es) or centre(s) where module will be delivered**
   GSK Stevenage

17. **Internationalisation**
   Techniques in purification and analysis are employed internationally to confirm the identity of new compounds developed from chemical reaction pathways and these techniques are discovered, 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. GSK is large multi-national organisation which enables students to appreciate the international aspects and benefits of scientific research and development.

18. **Partner College/Validated Institution**
   GSK Stevenage

19. **University School responsible for the programme**
   Physical Sciences

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

<table>
<thead>
<tr>
<th>Date approved</th>
<th>Major/minor revision</th>
<th>Start date of the delivery of revised version</th>
<th>Section revised</th>
<th>Impacts PLOs (Q6&amp;7 cover sheet)</th>
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Module Specification Template with Guidance (October 2017)