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| Module Title: | Sampling and Separation Science |
| Language of Instruction: | English |
| Credits: | 10 |
| NFQ Level: | 7 |
| Module Delivered In | 1 programme(s) |
| Teaching & Learning Strategies: | This module content previously outlined will be taught in a one hour theory class and one three hour practical session per week. The emphasis will be on the development of good laboratory techniques and experience in the art of chemical separations. Particular emphasis will be placed on the theory and applications of chromatography and other more traditional methods of chemical separation. To encourage an interest in the subject area students may be brought on industrial visits (where possible and appropriate) to illustrate the importance and industrial applications of the module content. |
| Module Aim: | The aim of this module is to impart knowledge of the importance of good sampling procedures and of the fundamental principles of separation methods used in chemical analysis and to provide practical training in this subject area with due regard to best practice and safety. |

| Learning Outcomes | |
|---|---|
| <i>On successful completion of this module the learner should be able to:</i> | |
| LO1 | Describe and discuss the importance of rigorous sampling procedures |
| LO2 | Discuss the principles and background chemistry involved in routinely used separation methods |
| LO3 | Discuss appropriate applications of the techniques studied. |
| LO4 | Perform the designated laboratory exercises with due regard to safety and best practice. |

| Pre-requisite learning | |
|--|--|
| Module Recommendations <i>This is prior learning (or a practical skill) that is recommended before enrolment in this module.</i> | |
| No recommendations listed | |
| Incompatible Modules <i>These are modules which have learning outcomes that are too similar to the learning outcomes of this module.</i> | |
| No incompatible modules listed | |
| Co-requisite Modules | |
| No Co-requisite modules listed | |
| Requirements <i>This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.</i> | |
| Successful completion of year 2 or equivalent | |

Module Content & Assessment

Indicative Content

Section 1.1

Sampling (representative) of solids, liquids and gases

Section 2.2

Solvent extraction. Principles, KD, D, pH, ion association, chelation, continuous and multiple extractions, K_a , clean-up and concentration techniques, calculations.

Section 1.3

Distillation: Fractional, reduced pressure and azeotropic distillation. Raoult's Law and deviations.

Section 1.4

Chromatography: Basic principles, adsorption, partition. Stationary and mobile phases. Separation on molecular level. Band broadening. Thin layer and Paper chromatography. Stationary and mobile phases, detectors.

Section 1.5

Gas Chromatography: Basic principles, detectors, columns, stationary phases, temperature programming, internal standards and quantitation, derivatisation, GC-MS. .

Section 1.6

Ion exchange chromatography. Resin choice, pH effects, ionic strength of eluents. Ion chromatography, chemical suppression, environmental analysis.

Section 1.7

High Pressure/Performance liquid chromatography. Basic principles, columns, stationary phases, detectors, sample preparation, sample clean-up, solid phase extraction, ion pairing reagents, gradient and isocratic elution, relative response factors, quantitative and qualitative analysis.

Section 1.8

Electrophoresis: Basic principles, high and low voltage electrophoresis, paper, gel and capillary electrophoresis.

Section 1.9

Size exclusion chromatography: principles and applications

Practical

The scheduled practicals will develop the following skills: solvent extraction, distillation, GC and HPLC separations (quantitative and qualitative), use of chromatographic software Empower, ion exchange chromatography, ion chromatography, TLC analysis, gel filtration, electrophoresis

| Assessment Breakdown | % |
|----------------------------------|--------|
| Continuous Assessment | 10.00% |
| Practical | 40.00% |
| End of Module Formal Examination | 50.00% |

Special Regulation

Students must achieve a minimum grade (35%) in both the practical/CA and final examination.

Continuous Assessment

| Assessment Type | Assessment Description | Outcome addressed | % of total | Assessment Date |
|-----------------|------------------------|-------------------|------------|-----------------|
| Examination | 1 hour exam | 1,2,3 | 5.00 | n/a |
| Case Studies | 1 hour exam | 1,2,3 | 5.00 | n/a |

No Project

Practical

| Assessment Type | Assessment Description | Outcome addressed | % of total | Assessment Date |
|-----------------------------|---------------------------|-------------------|------------|-----------------|
| Practical/Skills Evaluation | Practical Laboratory book | 4 | 40.00 | Sem 1 End |

End of Module Formal Examination

| Assessment Type | Assessment Description | Outcome addressed | % of total | Assessment Date |
|-----------------|------------------------|-------------------|------------|-----------------|
| Formal Exam | 3 hour exam | 1,2,3,4 | 50.00 | End-of-Semester |

Module Workload

| Workload: Full Time | | |
|----------------------------|--------------------|--|
| <i>Workload Type</i> | <i>Frequency</i> | <i>Average Weekly Learner Workload</i> |
| Lecture | 30 Weeks per Stage | 1.00 |
| Laboratory | 30 Weeks per Stage | 3.00 |
| Estimated Learner Hours | 30 Weeks per Stage | 2.00 |
| Total Hours | | 180.00 |

Module Delivered In

| Programme Code | Programme | Semester | Delivery |
|----------------|--|----------|-----------|
| CW_SASES_B | Bachelor of Science (Honours) in Environmental Science | 3 | Mandatory |