University of the
West of England

MODULE SPECIFICATION

Code: USSJR6-20-1 **Title:** Scientific and Analytical Skills **Version:** 2

Level: 1 **UWE credit rating:** 20 **ECTS credit rating:** 10

Module type: Standard

Owning Faculty: Health and Life Sciences **Field:** Applied Sciences

Faculty Committee approval: Quality and Standards Committee **Date:** September 2010

Approved for Delivery by: N/A

Valid from: September 2010 **Discontinued from:**

Pre-requisites:
None

Co-requisites:
None

Entry Requirements:
None

Excluded Combinations:
None

Learning Outcomes:

The student will be able to:

- address scientific problems using appropriate mathematical and statistical skills; assess their individual capabilities in analysis and presenting experimental data and recognise the degree of experimental uncertainty in experimental measures
- use electronic resources that will also support their problem solving skills throughout their undergraduate course;
- describe the functions of the components of basic analytical instruments and operate analytical instruments at a basic level,
- recognise and describe a range of routine analytical techniques available for the chemical analysis of biological molecules
- prepare and analyse simple biological samples using the above techniques appropriately;
- record experimental data in an appropriate manner, use it for the calculation of concentrations and other parameters of simple biological test samples and in the calibration of instruments;
- have gained the appropriate skills integral to the Graduate Development Programme;.

Syllabus Outline:

Entry Level Maths Skills
These are mathematical skills that a student with a grade C at GCSE Mathematics (or equivalent) should possess. These will not be taught explicitly, but students will be helped to remedy any deficiencies that they may have in this area.

Data Handling

Modelling scientific systems:
Scientific equations and formulae
Linear relationships and regression
Exponential and logarithmic functions. Equations of growth and decay
Variability in science – system variations, experimental uncertainty:

Probability, frequency. Use of normal distribution, Z-scores, confidence interval
Introduction to hypothesis testing: t-test

Presenting and analysis scientific data:
Use of EXCEL to display and analyse scientific information: formatting, graphs, use of formulae and functions, absolute and relative addressing. Descriptive statistics.

Analytical Science
General aspects of analysis: characteristics of analysis, qualitative, quantitative, bulk, trace, destructive, non-destructive; analytical accuracy and precision; standards, calibration of instruments; sensitivity, detection limits, quantitation limits; choice of methods

Spectroscopy: The electromagnetic spectrum, interaction of matter and electromagnetic energy, production of emission and absorption spectra, qualitative and quantitative uses of spectra; instrumentation and applications of UV-vis absorption, molecular fluorescence; instrumentation and applications of atomic spectroscopy

Chromatography: Origin of chromatographic separations; qualitative and quantitative parameters; manual procedures; instrumental methods, gas- and high-performance liquid-chromatography; applications for biological samples

Electrophoresis: Factors affecting electrophoretic separations; physical design of apparatus, horizontal and vertical arrangements; general interpretation of results; adaptations for specific purposes, SDS-PAGE, IEF, NA analysis

Electrochemical methods of analysis: pH and other potentiometric measurements; oxygen electrode and applications; electrochemical detectors in HPLC

Portfolio of activities contributing to the Graduate Development Programme

Teaching and Learning Methods:

The learning in the module during the first semester is carefully structured in units from the core text, which has itself evolved out of the learning materials developed specifically for this module. These units include explicit performance attainment targets identified by indicative questions and self-assessment tests. The resources also include direct tutorial material, and references to published material, software, internet and intranet resources. Where possible, and appropriate, the mathematical and statistical topics are presented and tested in the context of scientific problems. Specific use is made of computer workshop exercises to provide the broad context of scientific inquiry.

The learning processes of the students are based on:
 A clear knowledge of expected performance through indicative questions associated with the tutorial material.
 Selection of students into one of two study streams: standard and advanced.
 Weekly lectures/tutorials which establish the core direction of the module (syllabus content) and provide navigation for the students through the learning resource material.
 The testing of progress through self-assessment questions linked to portfolio assessment.
 Extensive tutorial support via Blackboard, including video learning.
 ‘Drop-in’ and individual support to address specific problems.

All students sit an initial diagnostic test that concentrates mainly on Entry Level Skills. The itemised results of this test will be fed back to the students so that they can identify any deficiencies in this area. Each student will be expected to work through tutorial material and self-assessment questions appropriate to any Entry Level deficiencies.

Support for student learning in all topic areas will be given through weekly lectures/tutorials (1 or 2 hours, depending on stream) which will be integrated with the self-assessment tests to ensure focussed help can be given to those students who need help in the particular areas. Each week, the students will develop IT and data analysis skills through a 1 hour computer-based workshop.

The Portfolio assessments will include the requirement to attempt on-line self-assessment tests, together with specific IT and paper-based assignments.

In the second semester analytical science will be taught through a combination of lectures, which will include short audio/visual presentations,tutorials, which will require preparation and follow-up work to be done by the student and practicals where students will get valuable hands on experience of analytical

methods

Graduate Development programme will be addressed through small group tutorials with the students' individual GDP tutor.

Reading Strategy:

All students will be encouraged to make full use of the print and electronic resources available to them through membership of the University. These include a range of electronic journals and a wide variety of resources available through web sites and information gateways. The University Library's web pages provide access to subject relevant resources and services, and to the library catalogue. Many resources can be accessed remotely. Students will be presented with opportunities within the curriculum to develop their information retrieval and evaluation skills in order to identify such resources effectively.

Any **essential reading** will be indicated clearly, along with the method for accessing it, e.g. students may be expected to purchase a set text, be given or sold a print study pack or be referred to texts that are available electronically, etc. This guidance will be available either in the module handbook, via the module information on Blackboard or through any other vehicle deemed appropriate by the module/programme leaders.

If **further reading** is expected, this will be indicated clearly. If specific texts are listed, a clear indication will be given regarding how to access them and, if appropriate, students will be given guidance on how to identify relevant sources for themselves, e.g. through use of bibliographical databases.

Indicative Reading List:

Currell G and Dowman A A, Mathematics and Statistics for Science, (Second edition) Wiley-Blackwell, 2009

Crow J., Bradshaw T. & Monk P., 2006, Chemistry for the Biosciences, OUP

Higson S.P.J., 2003, Analytical Chemistry, OUP

Potter G.W.H., 1994, Analysis of Biological Molecules, Chapman & Hall

Reed, R et al., 1998, Practical Skills in Biomolecular Sciences, Addison Wesley Longman

Skoog D.A., Holler F.J & Nieman T.A., Principles of Instrumental Analysis, 1998, Harcourt Brace

Assessment:

Weighting between components A and B (standard modules only) A: 40% B: 60%

FIRST ATTEMPT

First Assessment Opportunity

Component A *(controlled)*		**Element Wt (Ratio)**
Description of each element		*(within Component)*
EX1	Examination (1.5 hour) - examining the material covered in the maths and stats tutorials and computer workshops (Assessment Period 2)	1
EX2	Examination (1.5 hour) - examining the material covered in the analytical science lectures, practicals and tutorials (Assessment Period 2)	1
	Final Assessment	

Component B		**Element Wt (Ratio)**
Description of each element		*(within Component)*
CW1	Portfolio including GDP reflection	1
CW2	Laboratory work sheets	1

Second Assessment Opportunity (further attendance at taught classes is not required)

Component A *(controlled)*		**Element Wt (Ratio)**
Description of each element		*(within Component)*
EX3 Examination (3 hours)	**Final Assessment**	1

Component B	**Element Wt (Ratio)**
Description of each element	*(within Component)*
CW1 Portfolio including GDP reflection	1
CW2 Exercise in Typical Analytical Calculation and Result Interpretation	1

<u>SECOND (OR SUBSEQUENT) ATTEMPT</u> Attendance at taught classes is not required.

Specification confirmed by ……Date ……
(Associate Dean/Programme Director)