University of the West of England
BRISTOL

CORPORATE AND ACADEMIC SERVICES

MODULE SPECIFICATION

Part 1: Basic Data						
Module Title	Advanced Analytical Science					
Module Code	USSKBQ-30-3		Level	3	Version	1
Owning Faculty	Health and Applied Sciences		Field	Department of Biological, Biomedical and Analytical Science.		
Contributes towards	BSc Forensic Science; BSc Forensic Science (Chemistry).					
UWE Credit Rating	30	ECTS Credit Rating		Module Type	Standard	
Pre-requisites	Instrumental Analytical Science USSKB9-15-2		Co- requisites	None		
Excluded Combinations	None		Module Entry requirements			
Valid From	September 2016		Valid to	September 2022		

CAP Approval Date	28/03/2014

Part 2: Learning and Teaching	
Learning Outcomes	On successful completion of this module students will be able to: • appreciate both the theoretical principles and applications of advanced analytical techniques. • be familiar with the operation and uses of advanced equipment such as gas-chromatography/mass spectrometry. • understand the use of sophisticated databases and library searching as performed in mass spectrometry. • be prepared for a career if desired in analytical science in industry or in a research environment. • have some appreciation of novel research methods (such as in sensors) in the analytical field and their potential impact in forensic science and related areas. • compare and contrast different analytical approaches for the solution of a given analytical problem.
Syllabus Outline	**Gas chromatography** Instrumental requirements for capillary GC. Sample injection using split, splitless and

	on-column methods-a critique of different approaches. "Dead-volume" requirements of the system. Backflushing column switching and 2-dimensional methods. Theory of chromatography. Retention factor, separation factor, phase ratio. Column efficiency and resolution. The Van Deemter equation. **High Performance Liquid Chromatography** A detailed consideration of instrumentation for HPLC. Comparison with technique and applications of GC, classical column liquid chromatography and TLC. Separation mechanisms especially bonded phase chromatography with octadecylsilyl columns. Gradient elution in HPLC; theory and instrumental requirements. Ion chromatography and ion-pair chromatography. Optimisation of HPLC mobile phase. Current research in the analysis of drugs. **Coupled Techniques** Coupled chromatographic and spectroscopic techniques (especially GC-MS and HPLC-MS). The electrospray and atmospheric chemical ionisation interfaces in LC-MS. Collision-induced ion decomposition. **Electrochemical Methods** New electrode materials eg chemically modified carbon electrodes, surface modification with immobilised enzymes. Amperometric sensors and biosensors. Applications in pharmaceutical, environmental and biomedical analysis. Effect of capacity current on sensitivity, normal and differential pulse polarography. Applications. Stripping voltammetry. Preconcentration of metals by amalgam formation and of organics by adsorption at electrode surfaces. Applications. **Spectroscopy** Aspects of atomic spectroscopy: scope and application of absorption, emission and mass spectrometry to Forensic and Pharmaceutical Science for the investigation of various evidence types e.g. glass, paint, soils and gunshot residues. The wider applications of these techniques in chemical analysis laboratories will also be considered. NMR spectroscopy; principles of the technique and applications. **High Energy Techniques** X-Ray fluorescence and X-Ray Diffraction. Theoretical background. Generation of X-rays. Preparation of samples. Electron spectroscopy for chemical analysis (ESCA). Scanning electron microscopy, EDAX methods.
Contact Hours	The total contact hours in this module are 72 distributed between lectures, workshops/seminars and practical sessions.
Teaching and Learning Methods	**Scheduled Learning** Scheduled learning will include interactive lectures, problem-solving classes (for example in the interpretation of mass spectra and infra-red spectra) and practical classes. Practical classes will aim to emphasise the fundamental principles of various analytical techniques that are important in forensic science, and the effect of various instrumental parameters on the results. Lectures will be supported by additional reading material posted on Blackboard and the use of handouts. Case studies will be used to introduce some procedures . **Independent Learning** Students will be expected to spend a significant amount of time in private study consulting relevant text books, journal articles and recommended web sites. The possibilities and limitations of internet site use will be emphasised. Independent study will make up the total number of hours of study for this module to the notional 300 hours.

Key Information Sets Information	Key Information Sets (KIS) are produced at programme level for all programmes that this module contributes to, which is a requirement set by HESA/HEFCE. KIS are comparable sets of standardised information about undergraduate courses allowing prospective students to compare and contrast between programmes they are interested in applying for. **Key Information Set - Module data** *Number of credits for this module*: 30 Hours to be allocated: 300 Scheduled learning and teaching study hours: 72 Independent study hours: 228 Placement study hours: 0 Allocated Hours: 300 The table below indicates as a percentage the total assessment of the module which constitutes a - **Written Exam**: Unseen written exam. **Coursework**: Written assignment or essay, report, dissertation, portfolio, project The table below indicates as a percentage the contribution of each element to the total assessment of the module: Total assessment of the module: Written exam assessment percentage: 60% Coursework assessment percentage: 40% 100%
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. A detailed reading list will be made available to students through relevant channels, e.g. module handbooks and Blackboard.
Indicative	The following texts are recommended as core reading:

Reading List	• Holler, F. and Crouch S., (2013). *Skoog and West's Fundamentals of Analytical Chemistry*. 9th ed Andover: Cengage Learning. • Skoog, D. Holler, F. & Crouch, S. (2007). *Principles of Instrumental Analysis* 6th ed., Belmont,CA: Thomson Brooks/Cole. Other useful textbooks include: • Grob, R., Modern Practice of Gas Chromatography, Wiley-Interscience • Harris D., Quantitative Chemical Analysis, (7th edn) Freeman (2007) • Hibbert D. Introduction to electrochemistry Macmillan (1993). • Kazakevich Y., LoBrutto R., HPLC for Pharmaceutical Scientists, Wiley (2007). • Mermet J., Otto, M. Valcárcel M., Analytical chemistry : a modern approach to analytical science, Wiley VCH *(2nd ed 2004)* • Poole C., The Essence of Chromatography, Elsevier (2003) • Snyder, L.R., Kirkland, J.J., Dolan, J.W. Introduction to Modern Liquid Chromatography, Wiley (3rd Edition 2010). • Widmer M et al, Analytical chemistry-a modern approach, Wiley (2004) **Journals** Students have access to a very wide range of electronic journals through the University's electronic library, including the Science Citation Index, Science Direct (Collection of Elsevier journals), Wiley publications, and Taylor and Francis electronic journals. Students will be recommended to read specified articles from journals that include Journal of Forensic Sciences, Forensic Science International, Analytical Chemistry, Journal of Chromatography (A and B), Analytica Chimica Acta, Journal of Separation Science.

Part 3: Assessment	
Assessment Strategy	**Component A** Examination: 3 hours. This assessment carried out under controlled conditions will examine a broad area of the module material. The examination will consist of a mixture of calculation questions, essay-type questions and short answer questions. The paper will be formulated such that it is not possible for students to avoid completely a particular subject area of the module material. The duration of the examination will be 3 hours Preparation for the exam will be encouraged by the provision of workshops and problem-solving classes, supported by material from Blackboard. **Component B**. This assessment will involve the submission of two detailed practical reports chosen from the suite of practicals that students will perform. Marks will be allocated for researching the background of the practical, for the experimental results obtained, for the discussion of these results, and for answering questions at the end of the report. Thus, a wide variety of different skills will be assessed. All work is marked in line with the Department's Generic Assessment Criteria and will conform with university policies for the setting, collection, marking and return of student work. Assessments are described in the Module handbook that is supplied at the start of module and detailed marking schemes for elements of coursework, where appropriate, are provided in

	advance.

Identify final assessment component and element		
% weighting between components A and B (Standard modules only)	**A:** **60%**	**B**: **40%**

First Sit	
Component A (controlled conditions) **Description of each element**	**Element weighting** **(as % of component)**
1. 3 hour examination	100%
Component B **Description of each element**	**Element weighting** **(as % of component)**
1. Practical Report	100%

Resit (further attendance at taught classes is not required)	
Component A (controlled conditions) **Description of each element**	**Element weighting** **(as % of component)**
1. 3 hour examination	100%
Component B **Description of each element**	**Element weighting** **(as % of component)**
1. Practical Report supported by questions from the practical sessions.	100%

If a student is permitted an **EXCEPTIONAL RETAKE** of the module the assessment will be that indicated by the Module Description at the time that retake commences.