University of the West of England
BRISTOL

ACADEMIC SERVICES

MODULE SPECIFICATION

Part 1: Basic Data						
Module Title	Instrumental Analytical Science					
Module Code	USSKB9-15-2		Level	2	Version	1
Owning Faculty	Health and Applied Sciences		Field	Biological, Biomedical and Analytical Science.		
Contributes towards	BSc Forensic Science BSc Forensic Science (Chemistry) FdSc Forensic Science					
UWE Credit Rating	15	ECTS Credit Rating	7.5	Module Type	Standard	
Pre-requisites	Scientific Skills USSJRW-30-1 AND Chemistry in Context USSJRT-30-1 OR Chemistry for Forensic Science and Data Analysis USSKC5-30-1		Co- requisites	None		
Excluded Combinations	None		Module Entry requirements			
Valid From	September 2015		Valid to	September 2021		

CAP Approval Date	28/03/2014

Part 2: Learning and Teaching	
Learning Outcomes	On successful completion of this module students will be able to: • Perform an instrumental analysis of some complexity in the laboratory using equipment with computer control and sophisticated data handling. (Component B). • Understand the role of Analytical Science in the Forensic Science laboratory. (Component A) • Work safely in a laboratory while using a variety of techniques. (Component B). • Gain an appreciation of the application of instrumental analysis in forensic science (Components A and B). • Understand the factors involved in the choice of an analytical method to solve a given problem. (Component A) • Discuss the relevant theory and principles of instrumental analysis. (Component A) • Discuss data processing in the light of a deeper understanding of theoretical principles. (Component A)
Syllabus Outline	**Introduction**

	Terms and definitions. Macro and microanalytical methods. Trace and ultra-trace analytical procedures. Classical and Instrumental procedures. Factors involved in the choice of analytical methods. Precision and accuracy of analytical methods. Internal standards, standard addition, matrix matched standards. Use of National Institute of Standards (NIST) reference materials. Sample pre-treatment procedures. **Separation Methods** Instrumentation for gas and high performance liquid chromatography. Sample injection. Modes of separation-types of column, detectors. Applications in forensic and pharmaceutical science. Pyrolysis GC and its application to the identification of polymers. (e.g. car paints and plastics in forensic science) and microbiological samples. Headspace analysis. Comparison of GC and LC methodology-advantages and disadvantages of the techniques. **Mass spectrometry** Construction of a mass spectrometer. Sample introduction; linked GC and HPLC-MS. Sample ionisation and ion separation. Drug screening using Matrix Assisted Laser Desorption Ionisation (MALDI). Identification of drugs on banknotes using two dimensional MS. Other applications in forensic science. Library Searches using National Institute of Standards and other data bases of mass spectra. **Ion Selective Electrodes** Theoretical considerations. Selectivity Coefficients. Direct potentiometry and potentiometric titrations. Applications. **Polarography and voltammetry** Basic principles of polarography. Hydrodynamic voltammetry, amperometry in stirred solution. Oxygen electrode and glucose measurement. Linear sweep and cyclic voltammetry. Use in studying redox processes. Applications. **Spectroscopy** Principles and applications of UV and IR spectroscopy. Sample preparation methods. Applications in forensic and pharmaceutical Science.
Contact Hours	The total contact hours in this module are 36 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 e.g. rapid identification of contaminated banknotes using mass spectrometry. **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 150 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*: 15 Hours to be allocated: 150 | Scheduled learning and teaching study hours: 36 | Independent study hours: 114 | Placement study hours: 0 | Allocated Hours: 150 The table below indicates as a percentage the total assessment of the module which constitutes a - **Written Exam**: Unseen written exam, open book written exam, In-class test **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: 50% Coursework assessment percentage: 50% 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 Reading List	The following texts are recommended as core reading: • Holler, F. and Crouch, S., (2013) *Fundamentals of Analytical Chemistry*. 9th ed. Inca, CA: Cengage Learning.

	• Skoog, D. Holler, F. & Crouch, S. (2006) *Principles of Instrumental Analysis* (6th ed., Belmont, CA: Thomson Brooks. Other useful textbooks include: • Grob, R., (2004) *Modern Practice of Gas Chromatography*,Hoboken,NJ: Wiley-Interscience • Harris, D.,(2007) *Quantitative Chemical Analysis*, 7th ed. New York: W.H.Freeman. • Hibbert, D. (1993) *Introduction to electrochemistry* Basingstoke: Macmillan • Kazakevich, Y., LoBrutto, R., (2007) *HPLC for Pharmaceutical Scientists*, Hoboken, NJ: Wiley. • Mermet J., Otto, M. Valcárcel M., (2004) *Analytical chemistry : a modern approach to analytical science*.2nd ed. Weinheim: Wiley VCH • Poole C., (2003) *The Essence of Chromatography*. Amsterdam: Elsevier (2003) **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 a detailed practical report 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. Examples of practical work include building and testing a Visible spectrometer from the basic components; investigation of the parameters in gas chromatography that influence the optimum separation of fire accelerants. Opportunities exist for formative assessment in practical work that is not given in for marking.

Identify final assessment component and element		
	A:	**B**:

	50%	**50%**
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.	