UNIVERSITI TEKNOLOGI MARA

FRS651: FORENSIC CHEMICAL ANALYSIS

Course Name (English)	FORENSIC CHEMICAL ANALYSIS APPROVED
Course Code	FRS651
MQF Credit	4
Course Description	This course gives the student a basic understanding of the theory and applications of the methods of modern analytical chemistry as applied to forensic problems. The lectures include the theory of operation of various instruments and the fundamental science on which they are based. Applications of these instruments to forensic samples will be introduced. Topics include drug analysis, arson investigation and the analysis of paint and inks. The outcomes shall be assessed through a variety of tools which include the final examination, tests and quizzes, laboratory reports and presentation of case study.
Transferable Skills	Students should be able to: 1. analyze evidences by applying knowledge of fundamentals of chemistry and forensic science. 2. safely prepare sample and operate and use laboratory equipments when conducting experiments. 3. design and conduct chemistry and forensic chemical analysis experiments and to interpret data. 4. apply techniques and skills in solving chemistry and forensic related problems.
Teaching Methodologies	Lectures, Lab Work, Presentation
CLO	CLO1 Discuss forensic science techniques to justify which analytical technique is appropriate to a given forensic application CLO2 Display practical skills in experimental forensic related to chromatographic and spectroscopic analysis CLO3 Interpret data obtained in experiments related to chromatographic and spectroscopic analysis to write a report scientifically CLO4 Present verbally a chosen topic related to forensic analysis
Pre-Requisite Courses	No course recommendations

Topics

1. Drugs and toxic chemicals analysis
1.1) Types of drugs and toxic chemicals
1.2) Definition of volatile and non-volatile organic substances and common VOCs
1.3) Acidic drugs, basic drugs and their molecular structure
1.4) Types of samples in drug and toxic chemicals analysis (biological, food and environmental samples)
1.5) Sample preparation and extraction methods - Liquid-liquid extraction (LLE), solid phase extraction (SPE), solid phase microextraction (SPME), pressurized liquid extraction (PLE) / Accelerated solvent extraction (ASE), soxhlet, steam distillation, supercritical fluid extraction (SFE), microwave-assisted extraction (MAE) and headspace (HS) methods (direct, purge and trap and HS-SPME)
1.6) Analysis methods: Screening (Immunoassay, TLC, GC and CE), identification and quantification (GC-FID/NPD/ECD, GC-MS, pyrolysis GC, LC-DAD/LC-MS and LC-MS/MS) and application of capillary electrophoresis (MECC and CEC)
1.7) Recent developments and case studies

2. Arson analysis
2.1) Definition of arson and accelerant
2.2) Classifications and types of accelerant
2.3) Types of samples in arson analysis
2.4) Profiles of common accelerants - petrol/gasoline, diesel and kerosene
2.5) Factors that affect accelerant detection - types of accelerant, burned materials, burning time and air availability
2.6) Steps to recover and identify accelerants
2.7) Sample preparation and extraction methods - Solvent extraction, steam distillation, soxhlet, SFE, PLE, HS methods (Static and dynamic HS)
2.8) Analysis methods - GC-FID/NPD/ECD, GC-MS, pyrolysis GC and cryo-focussing
2.9) Recent developments and case studies

3. Spectroscopy analysis in forensic chemistry
3.1) Definition of forensic chemistry
3.2) Tasks of a forensic chemist
3.3) Flow of a forensic analysis
3.4) Basic spectroscopy - Absorbance spectrum, instrument design and bandwidth and resolution
3.5) UV-Visible absorption spectrometry - Basic principle, electron transition in molecules and UV-Vis spectrometer
3.6) Fourier transform infrared spectroscopy (FTIR) - Basic principle, dispersive IR and FTIR spectrometer, sampling techniques (transmission, DRIFTS and ATR-FTIR) and IR microscopy
3.7) Raman spectroscopy - Basic principle, origins of Raman, Raman spectrum and spectrometer and IR vs Raman
3.8) Atomic spectroscopy - Introduction to elemental/ atomic spectroscopy
3.9) Atomic absorption spectroscopy (AAS) - Basic principle, instrumentation, radiation sources, atomizers and sample preparation
3.10) Atomic emission spectroscopy (AES) - Basic principle, emission sources, ICP-OES and ICP-MS
3.11) Atomic X-ray spectroscopy - Instrument components, X-ray fluorescence methods, WDXRF and EDXRF, qualitative and quantitative analysis, applications of XRF and advantages and disadvantages of XRF

4. Ink and paint analysis
4.1) Colorants in inks
4.2) Colorants in paints - Binders and resins, additives and automotive paints

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment

Assessment Type	Assessment Description	% of Total Mark	CLO
Assignment	Assignment - video presentation	10%	CLO4
Test	Test from Part A	40%	CLO1
Written Report	One lab report summary from experiment 1-4	10%	CLO2

Reading List

Recommended Text

- **Bell, S 2006, *Forensic Chemistry.*, Pearson Prentice Hall New Jersey**
- **Skoog, D.A., Holler, F.J. and Crouch, S.R. 2006, *Principles of Instrumental Analysis.*, 6th edition. Ed., Thomson Learning London**
- **Harris, D.C. 2006, *Quantitative Chemical Analysis.*, 7th edition. Ed., W.H. Freeman. USA**
- **Dean, J.R. 1998, *Extraction Methods for Environmental Analysis.*, John Wiley & Sons. New York**
- **Rouessac, F. and Rouessac, A. 2007, *Chemical Analysis: Modern Instrumentation Methods and Techniques.*, 2nd edition. Ed., John Wiley & Sons. New Jersey**
- **Norashikin Saim, Ruziyati Tajudin and Mardiana Saaid. 2012, *Analytical Separation Methods Laboratory Guide.*, 2nd edition Ed., Pusat Penerbitan UiTM (UPENA). Shah Alam**

Article/Paper List

Recommended Article/Paper Resources

- **Matthew P. Juhascik* and Amanda J. Jenkins 2009, Comparison of Liquid/Liquid and Solid-Phase Extraction for Alkaline Drugs, *Journal of Chromatographic Science*, Vol. 47**
- **Graham A. Mills , Valerie Walker 2000, Review Headspace solid-phase microextraction procedures for gas chromatographic analysis of biological fluids and materials, *Journal of Chromatography A*, vol. 902, 267**

Other References

- **http://www.intechcopen.com S. Lakshmana Prabu1 and T. N. K. Suriyaprakash2 2012, *Extraction of Drug from the Biological Matrix: A Review* , In Tech, Croatia**