1. **Title of the module**

PSCI5120 (PS512) - Numerical, Statistical and Analytical Skills

1. **School or partner institution which will be responsible for management of the module**

Physical Sciences

1. **The level of the module (Level 4, Level 5, Level 6 or Level 7)**

Level 5

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Autumn and Spring

1. **Prerequisite and co-requisite modules**

Prerequisite:

Successful completion of Stage 1 of the Forensic Science or Chemistry degree programme, or equivalent.

1. **The programmes of study to which the module contributes**

BSc/BSc (Year in Industry) and MSci Forensic Science

BSc/BSc (Year in Industry) and MChem Chemistry

1. **The intended subject specific learning outcomes.
On successfully completing the module students will be able to:**

Have a knowledge and understanding of:

1. Core and foundation scientific physical and chemical concepts, terminology, theory, units, conventions, and laboratory methods in relation to forensic science and the chemical sciences. (FS A1, C A1)
2. Areas of chemistry as applied to forensic analysis. (FS A3)
3. Numeracy (including data analysis and statistics). (FS A5)

Intellectual skills:

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject and to apply such knowledge and understanding to the solution of qualitative and quantitative problems. (FS B8, C B5)
2. Ability to recognise and analyse problems and plan strategies for their solution by the evaluation, interpretation and synthesis of scientific information and data. (FS B9, C B6)
3. Ability to recognise and implement good measurement science and practice and commonly used forensic laboratory techniques. (FS B11)

Subject-specific skills:

1. Skills in the safe handling of chemical materials, taking into account their physical and chemical properties, including any specific hazards associated with their use and to risk assess such hazards. (FS C14, C C9)
2. Skills required for the conduct of standard laboratory procedures involved in analytical work, and in the operation of standard instrumentation used in analysis and separation in forensic and chemical sciences. (FS C15, C C10)
3. Ability to interpret and explain data derived from laboratory observations and measurements in terms of their underlying significance and the theory underpinning them, including an assessment of limits of accuracy. (FS C19, C C11)

Cross-referenced to programme learning outcomes for BSc/MSci Forensic Science & Forensic Chemistry (FS), and BSc/MChem Chemistry (C).

1. **The intended generic learning outcomes.
On successfully completing the module students will be able to:**

Have a knowledge and understanding of:

1. Problem-solving skills, relating to qualitative and quantitative information, extending to situations where evaluations have to be made on the basis of limited information. (FS D22, C D15)
2. Numeracy and computational skills, including such aspects as error analysis, order-of-magnitude estimations, correct use of units and modes of data presentation. (FS D23, C D16)
3. Information-retrieval skills, in relation to primary and secondary information sources, including information retrieval through on-line computer searches. (FS D24, C D17)
4. Information-technology skills such as word-processing and spreadsheet use, data-logging and storage, Internet communication, etc. (FS D25, C D18)
5. Time-management and organisational skills, as evidenced by the ability to plan and implement efficient and effective modes of working. (FS D27, C D20)
6. Generic skills needed for students to undertake further training of a professional nature. (C D14)
7. Study skills needed for continuing professional development and preparation for employment. (FS D29, C D21)
8. **A synopsis of the curriculum**

Trace Analysis:

Trace analysis: definitions, methods and problems. Sampling, storage and contamination. Quality control. Random and systematic errors; statistical treatment of data. Accuracy and precision. Signal/noise ratio. Sensitivity and detection limits. Choice of methods for trace analysis.

Units, dimensions, exponentials and logarithms:

Decimal places and significant figures. Units and dimensions: SI units, dimensional analysis. Manipulation of exponentials and logarithms. Power laws. Exponential decay and half-life. Beer-Lambert law, Arrhenius equation, Boltzmann distribution, Gaussian functions.

Chemical Arithmetic:

Balancing chemical equations. Amount of substance, molar quantities, concentration and volumetric calculations, gravimetric analysis, gas pressures and volumes.

Equilibrium calculations, strong and weak electrolytes pH, acid-base equilibria, buffer solutions. Solubility. Chemical kinetics: reaction rates, rate constants and orders of reaction.

Probability and Statistics:

Elementary probability, probability spaces, Venn diagrams, independence, mutual exclusion, expectation. Quantitative treatment of the effect of evidence: Bayes’ Theorem and conditional probability Samples and populations, mean, standard deviation, moments, standard error. Probability distributions: binomial, normal, poisson. Limiting cases. Use of normal tables. Significance testing and confidence limits. Hypothesis testing. The chi-squared test. A brief look at probability-based arguments used by expert witnesses, recent controversies and challenged convictions. Regression and correlation.

Laboratory work:

Analysis of alkaloids by HPLC.

Accelerant analysis by gas chromatography.

Analysis of metal cartridge cases and counterfeit coins using X-ray fluorescence spectroscopy.

Determination of copper by atomic absorption spectroscopy.

Quantifying substances in a mixture using UV-visible spectroscopy.

Isolation & purification of caffeine from tea leaves.

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**
* P. Monk & L. J. Munro Maths for Chemistry 2nd edition (Oxford, 2010) ISBN 0199541299
* S. K. Scott, Workbooks in Chemistry Beginning Mathematics for Chemistry (Oxford, 1995) ISBN 0198559305
* J. N. Miller and J. C. Miller, Statistics and chemometrics for analytical chemistry, 6th edition (Pearson Prentice Hall 2010), ISBN: 0273730428
* D. Lucy Introduction to statistics for forensic scientists, (Wiley, 2005) ISBN 0470022019
* M. R. Spiegel, Schaum’s outline of probability and statistics 4th edition (McGraw Hill, 2013) ISBN 9780071795579
* D. Rowntree Statistics without tears, (Penguin, 2000) ISBN: 0140136320. It’s non-mathematical and excellent for getting a grasp of concepts
1. **Learning and teaching methods**

Total contact hours: 47

Private study hours: 103

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods

Assignments (6 hours 16.0%)

Lab 1 (3 hours, 3.4%)

Lab 2 (3 hours, 3.4%)

Lab 3 (3 hours, 3.4%)

Lab 4 (3 hours, 3.4%)

Lab 5 (3 hours, 3.4%)

Lab 6 (3 hours, 3.4%)

Assignment (3 hours, 3.4%)

Examination 2hr (60%)

13.2 Reassessment methods

Like-for-like

1. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section12) and methods of assessment (section 13)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | *8.1* | *8.2* | *8.3* | *8.4* | *8.5* | *8.6* | *8.7* | *8.8* | *8.9* | *9.1* | *9.2* | *9.3* | *9.4* | *9.5* | *9.6* | *9.7* |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Private Study | **x** | **x** | **x** | **x** | **x** |  |  |  | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| laboratory | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |  |
| lectures | **x** | **x** | **x** | **x** | **x** |  |  |  | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lab/problem sheet | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** | **x** |
| Examination | **x** | **x** | **x** | **x** | **x** |  |  |  | **x** | **x** | **x** | **x** |  | **x** | **x** | **x** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered**

Canterbury

1. **Internationalisation**

Physics is an international subject with laws of physical sciences discovered and techniques developed and refined by physical scientists across the globe. Mastery of the subject-specific learning outcomes, will equip students to apply the theories and techniques of this module in a wide range of international contexts. The module team is drawn from the School of Physical Sciences, which includes many members of staff with international experience of teaching and research collaboration. In compiling the reading list, consideration has been given to the range of texts that are available internationally. The support SPS provides to its students is also attuned to our international student body.

**FACULTIES SUPPORT OFFICE USE ONLY**

**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
|  |  |  |  |  |
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Revised FSO Jan 2018