Confirmation that this version of the module specification has been approved by the School Learning and Teaching Committee:

11-3-15……………………………………….(date)

MODULE SPECIFICATION

1. Title of the module

CH534: Inorganic and Environmental Chemistry

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

School of Physical Sciences

1. Start date of the module

Academic year 2015-16

1. The number of students expected to take the module

150

1. Modules to be withdrawn on the introduction of this proposed module and consultation with other relevant Schools and Faculties regarding the withdrawal

PS508

1. The level of the module Intermediate [I], Honours [H] or Postgraduate [M])

-Intermediate [I]

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

*Credits 15, ECTS value 7.5*

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

Autumn and spring terms

1. Prerequisite and co-requisite modules

 CH308 Molecules Matter and Energy

1. The programmes of study to which the module contributes

Updated module for the MCHEM/BSc Chemistry and BSc Chemistry with Year in Industry and MSci/BSc Forensic Chemistry and BSc Forensic Chemistry with Year in Industry.

Note: Forensic Chemistry students will have the choice of either PS534 or CH534

This is not available as a wild module

1. **The intended subject specific learning outcomes (please refer to Programme Specifications)**

Knowledge and understanding of:

11.1 Understand the characteristic properties of the d and f-blocks elements and their compounds.

11.2 An understanding of the composition of soil and its analysis.

11.3 Appreciate developments in soil analysis and environmental chemistry in terms of heavy metal toxicity, diffusion, detection and remediation.

Intellectual skills:

11.4 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. In particular, the ability to link chemical structure to physical properties.

11.5 Ability to recognise and analyse problems and plan strategies for their solution by the evaluation, interpretation and presentation of scientific information and data.

11.6 The ability to use data-processing skills to search for, assess and interpret chemical information and data, particularly in performing comprehensive literature searches.

Subject-specific skills:

11.7 A knowledge and understanding of the d-block elements and their compounds.

11.8 A knowledge and understanding of f-block elements and their compounds

11.9 A knowledge and understanding of soil structure in relation to silicate composition, and how this affects ion diffusion in soils.

11.10A knowledge and understanding of the impact of heavy metal toxicity environmental mobility and bio-availability.

11.11 An understanding of preparation, purification and analysis of a range of inorganic compounds using techniques such as ion-exchange chromatography, infra-red and uv-vis spectroscopy

11.12 An ability to make use of appropriate texts, or other learning resources as part of managing their own learning.

11.13 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.

11.14 Skills required for carrying out documented standard laboratory procedures involved in synthetic and analytical work in relation to organic and inorganic systems. Skills in observational and instrumental monitoring of physiochemical events and changes. The systematic and reliable documentation of the above. Operation of standard analytical instruments employed in the chemical sciences.

11.15 The ability to collate, interpret and explain the significance and underlying theory of experimental data, including an assessment of limits of accuracy.

11.16 Ability to implement the execution of experiments.

1. **The intended generic learning outcomes:**

12.1 Communication skills, covering both written and oral communication.

12.2 Generic skills needed for students to undertake further training of a professional nature.

12.3 Problem-solving skills, relating to qualitative and quantitative information, extending to situations where evaluations have to be made on the basis of limited information.

12.4 Interpersonal skills, relating to the ability to interact with other people and to engage in team working within a professional environment.

12.5 Time-management and organisational skills, as evidenced by the ability to plan and implement efficient and effective modes of working. Self-management and organisational skills with the capacity to support life-long learning.

1. **A synopsis of the curriculum:**

Inorganic Chemistry:

Stereochemistry of metal complexes: geometrical, optical, structural, ionisation/hydration, linkage, coordination isomerism.

Bonding in transition metal complexes. Crystal field theory: crystal field splitting, factors effecting crystal field splitting, the spectrochemical series, low spin and high spin complexes, crystal field stabilisation energy (CFSE), hydration energy of M2+ ions, site selection in spinels and the Jahn Teller effect. Thermodynamic and kinetic stability of metal complexes. Stability constants. The chelate effect. Lability of ligands. Preparation and reactivity of transition metal complexes.

Colours of complexes: d↔d spectra, spin and Laporte selection rules, intensities of absorptions. Measurement of ligand field splitting energy. Charge transfer absorptions. Diamagnetism, paramagnetism, magnetic moment.

Comparison with the d-block elements. Position of lanthanides and actinides in the periodic table. Electronic configuration, oxidation states and chemistry. The lanthanide contraction. Separation of lanthanide elements. f↔f spectra. Chemistry of actinides: uranium.

Soil and Environmental Chemistry]:

Silicates and other common minerals. Soil types, pollution, and analysis. Toxicity of elements and compunds; speciation, ion exchange, environmental mobility and bio-availability.

Laboratory:

Experiments in preparative and analytical inorganic chemistry, to include: the separation of nickel and cobalt by ion-exchange chromatography; measurement of the ligand field splitting energy in a titanium (III) complex; preparation and properties of complex ions; isomerism in coordination complexes

1. Indicative Reading List

Cotton, Wilkinson and Gaus, *Basic Inorganic Chemistry*. (3rd edition, 1995, Wiley).

Greenwood and Earnshaw, *Chemistry of the Elements*. (2nd revised edition, 1997, Butterworth-Heinemann Ltd).

Winter, *d-Block Chemistry*, (1994, Royal Society of Chemsitry)

Jones, *d- and f-Block Chemistry*, (2001, Royal Society of Chemistry).

Bell, *Forensic Chemistry*, (2nd edition, 2012, Prentice Hall).

Tan, *Principles of Soil Chemistry* (2010, CRC Press)

Sparks, *Environmental Soil Chemistry* (2003, Academic Press)

1. Learning and Teaching Methods, including the nature and number of contact hours and the total study hours which will be expected of students, and how these relate to achievement of the intended module learning outcomes

*Learning and Teaching Methods:*

Contact hours: 23 hrs lectures, 18 hrs practical laboratory experiments; total contact hours: 41; total study hours: 150

Achievement of module Learning Outcomes:

-Lectures delivered, supported by assignments; personal study using textbooks, and primary literature. (outcomes 11.1, 11.2, 11.3, 11.4, 11.5,-11.10, 11.12, 12.3, and 12.5)

-Lectures (gathering and ordering information), and assignment (problem solving and applying theory to complex series of transformations). (outcomes 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.12, 11.14, 11.15, 12.3, and 12.5)

-Practical experiments: gathering and ordering information, problem solving and applying theory in a laboratory setting. (outcomes 11.11, 11.13, 11.14, 11.15, 11.16, 12.1, 12.2, 12.3, 12.4, 12.5)

-Personal study using textbooks, web-based material and primary journal literature. (Outcomes 11.12, 12.2, 12.3, and 12.5).

1. Assessment methods and how these relate to testing achievement of the intended module learning outcomes

3 Assignments – (total 15%) Address outcomes 11.1, 11.2, 11.3, 11.4, 11.5,-11.10, , 11.12, 12.3, and 12.5.

Laboratory – (total 25%) Address outcomes 11.11, 11.13, 11.14, 11.15, 11.16, 12.1, 12.2, 12.3, 12.4, 12.5.

Final examination (2 hrs)– (60%) Address outcomes 11.1, 11.2, 11.3, 11.4, 11.5,--11.10, 11.12, 12.3, and 12.5.

1. Implications for learning resources, including staff, library, IT and space

Some additional staff workload will be allocated.

1. The School recognises and has embedded the expectations of current disability equality legislation, and supports students with a declared disability or special educational need in its teaching. Within this module we will make reasonable adjustments wherever necessary, including additional or substitute materials, teaching modes or assessment methods for students who have declared and discussed their learning support needs. Arrangements for students with declared disabilities will be made on an individual basis, in consultation with the University’s disability/dyslexia support service, and specialist support will be provided where needed.
2. Campus(es) where module will be delivered:

Canterbury