1. **Title of the module** CH742: Advanced concepts in physical and inorganic chemistry
2. **School or partner institution which will be responsible for management of the module**

School of Physical Sciences

1. **The level of the module (e.g. Level 4, Level 5, Level 6 or Level 7)** Level7
2. **The number of credits and the ECTS value which the module represents** 15 (ECTS 7.5)
3. **Which term(s) the module is to be taught in (or other teaching pattern)** terms 1 & 2
4. **Prerequisite and co-requisite modules**

Successful completion of stage 3 of the Chemistry Programme to threshold required for progression into Stage 4

1. **The programmes of study to which the module contributes** MChem
2. **The intended subject specific learning outcomes.**On successfully completing the module students will be able to:
	1. Describe electronic states using term symbols, understanding their meanings for spin and orbital angular momentum; to be able to identify microstates for an electron configuration and groups these by term symbol.
	2. Understand and be able to apply angular momentum coupling schemes to d and f block species.
	3. Evaluate the schemes in section 8.2 above and have a critical understanding of the limits of their application and their deficiencies.
	4. Apply the theories and methods to interpreting electronic spectra and physical properties of d and f block species in section 8.2 above and to highlight deviations from these theoretical models.
	5. Demonstrate knowledge and understand of key concepts in interfacial science, including colloids, surface energy, and adsorption, including some mathematical analysis.
	6. Identify appropriate characterisation techniques for colloids and surfaces, and interpret the resulting data.
	7. Describe nanoscale and macroscopic applications of colloids and surfaces in terms of their chemistry.
3. **The intended generic learning outcomes.**On successfully completing the module students will be able to:
	1. Analyse problems and plan strategies for their solution by evaluating and interpreting qualitative and quantitative information, extending to situations where evaluations have to be made on the basis of limited information.
	2. 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.
	3. Demonstrate independent learning and the ability to evaluate relevant research and suggest future directions and developments.
	4. Demonstrate the generic skills needed for students to undertake further training of a professional nature.
	5. Use data-processing skills and search engines to search for and critically assess the scientific literature and to make use of the results.
4. **A synopsis of the curriculum**

Topic A

The properties of species containing transition metals and lanthanides are governed by the electronic structure of these metals and ions and a more in-depth understanding of their electronic states is necessary to explore these properties and current research trends. This course will include looking at the energy scales of ss, ll and sl coupling and the Russell-Saunders coupling scheme and when various coupling schemes are valid, and Hund’s rules for transition metals and lanthanides. This will lead into the use of term symbols to discuss electron configurations and microstates. This initial theory will provide a basis on which we can investigate ligand field theory and electronic spectra for transition metals (considering concepts such as Racah parameters and the nephelauxetic effect, and using Orgel, Tanabe-Sugano and correlation diagrams) and then lanthanides. The consequences of these concepts for physical properties (for example, magnetism and when to expect an orbital contribution to spin) will be explored. Current research ideas will also be incorporated (for example, spin-crossover systems).

Topic B

Nanoscale phenomena are increasingly important in cutting edge materials science. Understanding colloids and interfaces is integral to entry into this field. Students will learn the physical chemistry of these systems, starting from classifications, and move forward to understanding the thermodynamics and kinetics through application of principles of structural chemistry. Characterisation and up-to-date applications of colloidal systems will be delivered.

1. **Reading List (Indicative list, current at time of publication. Reading lists will be published annually)**
* “Advanced Inorganic Chemistry”, sixth edition, F. A. Cotton and G. Wilkinson (New York; Chichester: Wiley), 1999, ISBN 0471199575
* “Inorganic Chemistry”, fourth edition, C. E. Housecroft and A. G. Sharpe (Harlow, England; New York: Pearson), 2012, ISBN 0273742787;ISBN 9780273742784
* “Lanthanide and actinide chemistry”, S. Cotton (Chichester: John Wiley), 2006, ISBN 9780470010068
* “Interfacial science: an introduction,” second edition, G. T. Barnes and I. R. Gentle (Oxford: Oxford University Press), 2011, ISBN 9780199571185
* “Colloids and Interfaces with Surfactants and Polymers: An Introduction,” J. Goodwin (Wiley), 2004, ISBN: 9780470841433
* Relevant articles in peer-reviewed scientific journals
1. **Learning and Teaching methods**

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| --- | --- |
| **Activity** | **Learning outcomes** |
| Lectures on background and theory aspects (Topic A) | 8.1 – 8.3, 9.1 |
| Lectures on current trends in related research (Topic A) | 8.3 – 8.4, 9.3 |
| Lectures on background and applications of interfacial and colloidal phenomena (Topic B) | 8.5 – 8.7, 9.1, 9.3 |
| Workshops (e.g. term symbols and microstates, coupling schemes, electronic spectra and physical properties, topical research, problem solving in colloidal and surface chemistry) | 8.1 – 8.7, 9.1 – 9.3 |
| Private study: assimilating lecture and workshop material; analysis & interpretation of laboratory data and report writing; review of topical research paper. | 8.1 – 8.7, 9.1 – 9.5 |

1. **Assessment methods.**

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| --- | --- | --- |
| **Weighting** | **Assessment** | **Learning outcomes** |
| 80% | Final written examination | 8.1 – 8.7, 9.1 |
| 10% | Research reviews (private study) | 8.1 – 8.7, 9.1 – 9.5  |
| 10% | Other continuous assessment (problem solving and critical thinking). | 8.1 – 8.7, 9.1 – 9.5  |

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 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 |
| **Learning/ teaching method** | **Hours**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Private Study** | 120 | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** |
| Lectures | 24 | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** |  | **✓** |  |  |
| Workshops | 6 | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** |  | **✓** |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Research review A |  |  | **✓** | **✓** | **✓** |  |  |  | **✓** | **✓** | **✓** | **✓** | **✓** |
| Research review B |  |  |  |  |  | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** |
| Other continuous assessment |  | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** |
| Examination |  | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** | **✓** |  |  |  |  |

1. **The School/Collaborative Partner (delete as applicable) 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 student support service, and specialist support will be provided where needed.**
2. **Campus(es) or Centre(s) where module will be delivered:** Canterbury

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

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| 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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