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

………19th June 2015………………………………………….

**MODULE SPECIFICATION**

1. Title of the module

CH530 Polymeric and Organic Materials

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

School of Physical Science

1. Start date of the module

Revised specification for existing module, next running 2015-2016

1. The number of students expected to take the module

50

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 Modules to be withdrawn on the introduction of this proposed module and consultation with other relevant Schools and Faculties regarding the withdrawal

None

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

Level 5

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

*15 (ECTS value 7.5)*

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

Terms 1 and 2

1. Prerequisite and co-requisite modules

CH309 CH382/PS381, and CH314 as prerequisite; CH506 as co-requisite

1. The programmes of study to which the module contributes

New module for the MChem/BSc Chemistry, BSc Chemistry with Year in Industry, MSci/BSc Forensic Chemistry, and BSc Forensic Chemistry with Year in Industry programmes.

This is not available as a wild module

1. The intended subject specific learning outcomes

Knowledge and understanding of:

11.1 Fundamental concepts relating to polymer chemistry.

11.2 Operating instrument and interpreting spectra from spectroscopic data.

11.3 Structure-property relationships liquid-crystal (LC) materials.

11.4 Synthetic approaches to polymers, LCs, and light emitting organics.

11.5 Concepts relating to spectroscopy

Intellectual skills:

11.6 An ability to interpret spectroscopic data.

11.7 An ability to link chemical structure to experimental observables

11.8 The skills to perform practical experiments to gain spectroscopic information.

11.9 The skills to operate standard chemical instrumentation, record data, evaluate observations and errors.

Subject-specific skills:

11.10 A knowledge of basic spectroscopy; infra-red, UV-VIS, fluorescence.

11.11 An understanding of how polymers are synthesised and analysed.

11.12 More detailed understanding of small molecule synthesis approaches.

11.13 A knowledge of LC behaviour and how it relates to observable properties.

11.14 A basic understanding of device compositions.

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

1. The intended generic learning outcomes:

12.1 Problem-solving skills, an ability to formulate problems in precise terms and to identify key issues, and the confidence to try different approaches in order to make progress on challenging problems.

12.2 Analytical skills – associated with the need to pay attention to detail and to develop an ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly.

12.3 Personal skills – the ability to work independently, to use initiative, to organise oneself to meet deadlines and to interact constructively with other people.

1. A synopsis of the curriculum:

**Module Aim:** By employing a ‘chemistry in context’ approach, the topics outlined below (Polymers, LCs, LEOs, and OLEDs) will function as information conduits. These are topics relevant to the ‘digital native’ cohorts entering UoK’s Chemistry programmes. The aim of this module is to deliver fundamental concepts of synthetic organic chemistry, polymer chemistry, some ‘soft materials’ chemistry, ideas of structure-property relationships, and basic MO theory in concepts relating to conductive and emissive organics, while giving context to the make-up and operation of modern-day materials / devices.

Lectures (24 lectures):

I) Polymers:

1) Macromolecules: definition; nomenclature.

2) Molecular weight parameters: polymers in solution; measuring molecular weight.

3) Polymerisations: chain growth & step growth; radical, ionic, condensation, ring-opening mechanisms; living *vs* controlled polymerisations; kinetics of polymerisations; emulsion polymerisation; inorganic polymers.

4) Properties of polymers: crystallinity; melting points, glass-transition temperatures.

 5) Plastic *vs* rubber.

II) Liquid Crystals:

1) LC-displays: deconstructed.

2) Synthesis: synthetic evolution of LCs; ester to biphenyl; straight chain to chiral (and reasons for).

3) Properties: macroscopic-*vs*-microscopic-*vs*-molecular; structure property relationships (hydrogen Bonding, pi-stacking, electrostatics); different phases and how they impact displays (and common uses).

1. Conjugated polymers: basic theory; properties.

III) Light Emitting Organics:

1) Fluorescence: Recap of basic principles of fluorescent emission (including basic MO theory); short vs long chain emitters and molecular emitters

2) Synthesis: synthesis of common colored emitters (Red, Green, Blue, Yellow); source of the color (emission process for each emitter); Design considerations (stability, aggregation, amount of conjugation)

3) Properties: structure-property relationships, tuneability; applications

4) LCs *vs* OLEDs: device make-up and comparisons; properties of each component in relation to devices

5) Phosphorescence: Recap of basic principles of phosphors vs fluorophors; phosphorescent d-block and f-block metal complexes; basic MO theory in relation to metal-based emission; metal-based phosphors in devices (examples and synthesis).

Practical Lab Component:

Two laboratory experiments performed over three 6 hr laboratory days make up the practical component of CH530. Titles of the experiments are as follows: Synthesis of cyclic and polymeric siloxanes (over 2 lab days); Synthesis and analysis of polystyrene (1 lab day).

Aims of the practical sessions include: exposure to synthetic chemistry, spectroscopic techniques, materials characterisation techniques, and current chromatography technologies - gel permeation chromatography (GPC).

1. Indicative Reading List

Indicative Reading List: (i) G. Solomons, *Organic Chemistry* 11th Ed. (2013) (ii) J. M. G. Cowie, Polymers: *Chemistry and physics of Modern Materials* 3rd ed. (2008) (iii) Y. Jean, F. Volatron and J. Burdett*, An introduction to molecular orbitals* (1993) (iv) S.-S. Sun, L. R. Dalton, *Introduction to Organic Electronic and Optoelectronic Materials and Devices* (2008) (v) P. J. Colllins, M. Hird, *Introduction to Liquid Crystals: Chemistry and Physics (1997)*.

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: 24 hours of lectures, 3 practicals (18 lab hours), 3 hours of drop-in sessions.

3 assignments and private study hours: 105; Total Study Hours: 150.

*Achievement of module Learning Outcomes:*

Lectures – contribute to outcomes 11.1, 11.3-11.7, 11.10-11.15, and 12.1-12.2.

Drop-in sessions – contribute to outcomes 11.1, 11.3-11.7, 11.10-11.15, and 12.1-12.3.

Practical lab classes – contribute to outcomes 11.1-11.11, and 12.1-12.3.

Personal study using textbooks, and other self-study material. – contribute to outcomes 11.1, 11.3 to

 11.7, 11.10-11.15, and 12.3.

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

3 practical (18 lab hours) 18%, 3 assignments 22%, 1 final examination (length 2 hours) 60%

Practicals – address outcomes 11.2, 11.6-11.9 and 12.1-12.3

Assignments – 3 written pieces of course work

(testing the success of outcomes 11.1-11.5, 11.10 to11.15 and 12.1-12.3).

Final examination

(testing the success of outcomes 11.1-11.5, 11.10-11.15 and 12.1-12.3)

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

None

1. The School/Collaborative Partner 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/Collaborative Partner’s disability/dyslexia support service, and specialist support will be provided where needed.
2. Campus(es) where module will be delivered:

Canterbury