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MODULE SPECIFICATION FORM

Module Title: **Chemistry and Technology of Water Soluble Polymers**	Level: 7	Credit Value: 20

Module code: SCI712	Cost Centre: GAWS	JACS3.0 code: F162

Trimester(s) in which to be offered: 1	With effect from: September 2013

Office use only: To be completed by AQSU:	Date approved: September 2013 Date revised: - Version no: 1

Existing/New: New	Title of module being replaced (if any):	Chemistry and Technology of Water Soluble Polymers (validated for MRes in Sept 2008)

Originating Academic Department:	Chemistry	Module Leader:	Prof. Peter Williams

Module duration (total hours):	200 hrs	Status: core/option/elective (identify programme where appropriate):
Scheduled learning & teaching hours	36 hrs lectures/practical demonstrations 6 hrs tutorials	Core
Independent study hours	158 hrs	

Programme(s) in which to be offered: MSc Formulation Science MSc Polymer and Biopolymer Science	Pre-requisites per programme (between levels): None

Module Aims:

Water soluble polymers are widely encountered in a range of industrial sectors – including

food, pharmaceuticals, cosmetics, water treatment, agrochemical, paints, inks, adhesives, surface coatings, paper making, personal care, petroleum recovery, ceramics etc. This module seeks to provide the student with a systematic knowledge and understanding of the latest developments relating to these materials. It specifically aims to:

- Introduce students to both natural and synthetic water soluble polymers
- Inform students of advances in polymer synthesis, molecular characterisation, physicochemical properties in solution, phase behaviour, adsorption at interfaces, effects on colloid stability and applications.
- Enable students to analyse and critically interpret complex data
- Develop students' originality in problem solving.
- Build students' proficiency and self– confidence in undertaking and reporting experimental investigations.

Expected Learning Outcomes:

At the end of this module, students will be able to:

Knowledge and Understanding:

1. Exhibit a comprehensive knowledge of the various types of commercially important water soluble polymers.
2. Evidence current knowledge of the synthetic methods in the field of water soluble polymers.
3. Identify and critically appraise experimental techniques for measurement of the physicochemical characteristics of water soluble polymers.
4. Demonstrate a systematic understanding and critical awareness of the solution and interfacial behaviour of water soluble polymers at the forefront of current knowledge.
5. Independently carry out and if necessary adapt practical investigations pertinent to the field of water soluble polymers.

Transferable/Key Skills:

Critically evaluate data published in the scientific literature. Report the results of practical investigations in a laboratory notebook and more formally as a written report.

Assessment: please indicate the type(s) of assessment (eg examination, oral, coursework, project) and the weighting of each (%). ***Details of indicative assessment tasks must be included.***

Assessment is intended to allow the learner to demonstrate skills that cover the entire breadth of the programme aims – knowledge and understanding, key practical skills, intellectual skills in interpreting data and report writing.
The learning outcomes will be assessed by:

Assessment (1) a formal written unseen examination testing the student's knowledge and understanding of the course material and
Assessment (2) a portfolio comprising laboratory reports for each of 10* laboratory investigations undertaken throughout the course, and laboratory notebook

*may be reduced to 6 for appropriately experienced PT students.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting	Duration (if exam)	Word count (or equivalent if appropriate)
1	All	Examination	50%	2.5 hours	N/A
2	All	Portfolio	50%	N/A	

Learning and Teaching Strategies:

The basic factual material will be delivered by means of lectures and laboratory demonstrations supported by group discussions and tutorials in which the students will be able to test their knowledge and understanding of the concepts involved. The remainder of the allotted hours are devoted to tasks through directed learning. A significant element of this is completion of 10* 4-hour practical investigations. Each of these are presented to the student in the form of a folder comprising appropriate research articles, risk assessment guidance, a standard operating procedure for the instrument(s) involved and an outline of the investigation to be made. Whilst these are designed to foster independent learning, programme team members will be available to provide support where necessary. These tasks facilitate development of the student's ability to critically assess their own experimental data against that reported in the scientific literature.

*or 6 4-hour practical investigations for PT students.

Syllabus outline:

Commercially important water soluble polymers. An overview of the various types of water soluble polymers in common use. Consideration of properties that have led to their success.

Synthesis of water soluble polymers, including linear and branched polymers, homopolymers, block and graft copolymers. Review of latest developments in polymer synthesis.

Determination of the physicochemical characteristics of water soluble polymers. Measurement techniques for determination of key properties e.g. molecular mass (and its distribution) and hydrodynamic size. Comparison / evaluation of values measured using different techniques.

Viscosity and viscoelastic properties of polymers in solution. Basis for viscosification and gelation in aqueous solutions of synthetic water soluble polymers. Structure-function relationships.

Polymer – surfactant interactions. Molecular basis of interactions and instrumental techniques appropriate to their investigation. Promotion of beneficial effects / limitation of deleterious effects.

Adsorption of polymers onto surfaces including techniques for determination of adsorption isotherms, adsorbed layer thickness, adsorbed polymer configuration.

Influence of polymers on colloid stability including electrostatic and steric stabilisation, bridging and depletion flocculation. Examples of beneficial and deleterious effects.

Future perspectives for water soluble polymers. Environmental / safety considerations, e.g. biodegradability, sustainability, toxicity. Consumer demands. Factors affecting supply and price stability. New markets.

Bibliography:

Essential reading:

COSGROVE, T. (ed.) (2010) *Colloid Science: Principles, Methods and Applications*. (2nd ed.) Chichester: John Wiley & Sons Ltd.

HOLMBERG, K., JONSSON, B., KRONBERG, B & LINDMAN, B. (2003) ***Surfactants and Polymers in Aqueous Solution*** **(2nd Ed.)** Chichester: John Wiley & Sons Ltd.

WILLIAMS, P.A. (Ed). (2007) *Handbook of water soluble polymers*, Oxford: Blackwell Publishing Ltd.

Other indicative reading:

BRAUN, D.; CHERDON, H., REHAHN, M., RITTER, H., and VOIT, B.(2005) *Polymer Synthesis: Theory and Practice: Fundamentals, Methods, Experiments.* Berlin: Springer-Verlag.

SALDIVAR-GUERRA, E. and VAVALDO-LIMA, E. (eds.) (2013) *Handbook of polymer synthesis, characterisation and processing.* Hoboken: John Wiley & Sons Inc.

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